



# ANNALS OF SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

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No. 1

## BRANCHIOGENIC CARCINOMA

BY FRANK WARNER, M.D.

OF COLUMBUS, OHIO

A STUDY of the embryology of the neck gives a clear and comprehensive idea of the method of the development of branchiogenic fistulae and cysts upon the one hand, or of branchiogenic carcinomata upon the other. In early fetal life, serial sections made in the region of the developing pharyngeal regions, four arches, or gill bars, are seen upon either side, separated by three grooves of greater or less depth both internally and externally, constituting an infolding of the entoderm and ectoderm into the tissue between, the mesoderm. The membrane between the inner and outer grooves constitutes the plates. Sometimes, the grooves cut on through, then, in the event of a failure of the clefts to close, a fistula will result.

These clefts close normally later in fetal life with the exception of the first, from which the external auditory canal and eustachian tube is formed.

If any one of the other clefts fail to close through its entire length, a cyst is the result.

A carcinoma may develop from this cyst wall. If glandular in type, it is from the entoderm, while an epidermoid may take its origin from this membrane or the ectoderm.

Even when the clefts close in the normal manner, it is easy to conceive that these epithelial linings are included in the tissues of the neck, and become embryonal, or cell rests, from which a carcinoma may later arise.

Speese<sup>1</sup> says: "These plates form the four branchial arches, three clefts remaining between them which, in early life, unite, with the exception of the second." (First.) "From this one is formed the cavity of the tympanum, the eustachian tube, and the external auditory canal." He concludes: "It is now generally admitted that lateral fistulas originate from the second branchial cleft."

<sup>1</sup> Speese: Contributions from the Laboratory of Surgical Pathology, University of Penn., p. 10.

<sup>2</sup> Bailey and Miller: Text-book on Embryology, p. 147.

Bailey and Miller<sup>2</sup> read: "The first branchial groove is relatively large and marks the site of the external auditory meatus." They continue, p. 621, "It sometimes happens that during the closure of the branchial grooves portions of the walls of the grooves become enclosed within the walls of the pharynx, that is, within the sides of the neck. This abnormal process results in various forms of cysts and tumors. If derived from the external furrows, they are dermoid in character, lined with ectodermal derivatives, and contain sebaceous material. If derived from the internal furrows they contain mucous fluid, the lining epithelium is likely to be columnar and is claimed by some to be ciliated."

Prentiss<sup>3</sup> says: "The external ear is developed from and about the first branchial groove." He continues, p. 170. "By the growth and lateral expansion of the pharynx, the second pouch is taken into the pharyngeal wall, its dorsal angle alone persisting to be later transformed into the palatine tonsil."

The third branchial cleft gives rise to the parathyroid bodies and the thymus gland. So, epithelial tumors arising lower in the neck may either have their origin in one or the other structures, or from some of the epithelial inclusions from this third cleft.

There is also a rudimentary fourth cleft and fifth arch from which post-branchial carcinomata may take their origin.

Some writers have been a little backward in ascribing the development of these neck tumors to epithelial embryonic inclusions. Morris<sup>4</sup> makes this point clear when he says:

"What proof have we that a matrix of embryonic tissue, whether of embryonic or acquired origin, can remain for a length of time in a quiescent state, and then suddenly start into active growth under the influence of some stimulus? This is actually witnessed in the growth and development of the teeth, bones, the skin and its appendages, the larynx, the mamma, and the organs of generation, the cells of which remain for years in a state of incomplete differentiation, and then normally, under the physiological stimulus which occurs at puberty, take on rapid proliferation. Pathologically, the same suddenly aroused activity is seen in certain epithelial tumors which are rarely noticed before puberty, such as dermoids and mammary adenomata. Rudimentary organs, which hitherto as to growth have been stationary as well as functionless, become the starting points of tumors, more especially at and after puberty."

The following case of epidermoid carcinoma, seemingly taking its origin from epithelial embryonic inclusions of the second gill cleft, occurred in my practice:

F. A. W., male, aged forty-nine, consulted me July 25, 1915, on account of a lump on the neck, in the upper triangle, just in front

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<sup>2</sup> Prentiss: Text-book on Embryology, p. 387.

<sup>4</sup> Henry Morris: Cancer and Its Origin, British Med. Jour., December 12, 1903, p. 1505.

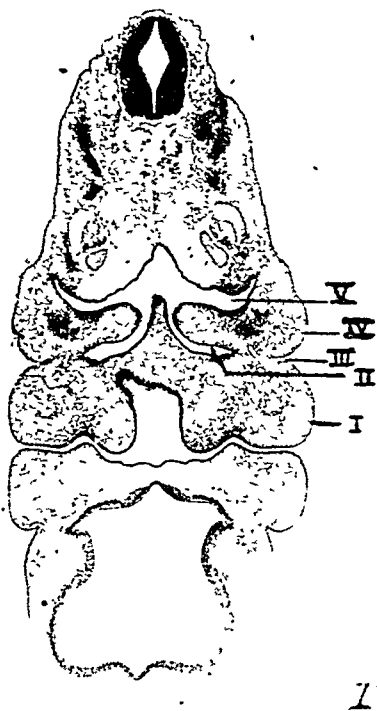


FIG. 1.—Transverse section passing through first and second pharyngeal pouches of a 9 mm. pig embryo. I, IV, branchial arches, first and second; III, first branchial cleft; II, first pharyngeal pouch; V, second pharyngeal pouch.

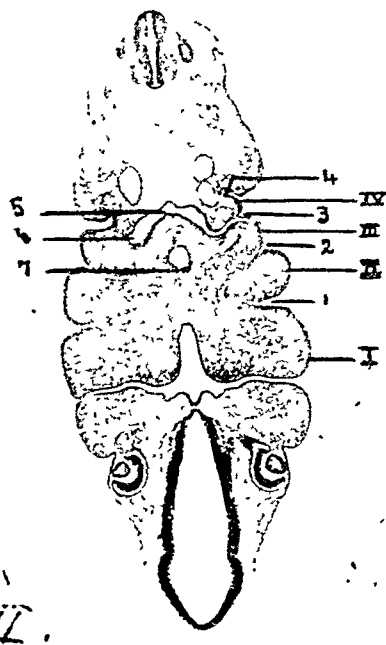


FIG. 2.—Transverse section passing through third pharyngeal pouch of a 9 mm. pig embryo. I, II, III, IV, branchial arches; 1, 2, 3, 4, branchial clefts; 5, pharynx; 6, third pharyngeal pouch; 7, anlage of the thyroid gland.



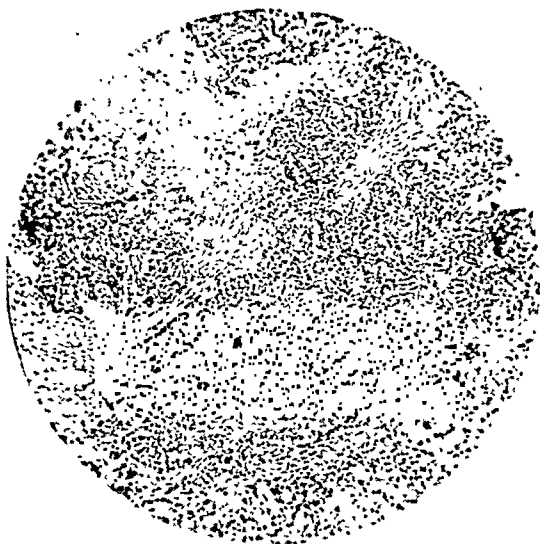


FIG. 3.—Photomicrograph of section from tumor. Note the formation of epithelial pearls.

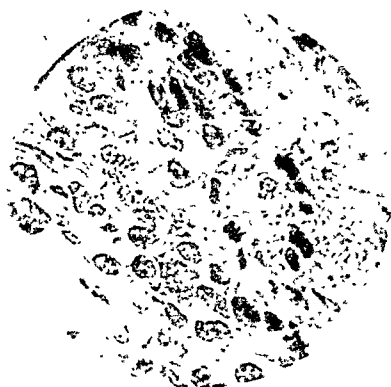


FIG. 4.—Note the mitotic figures in this area of the carcinoma.

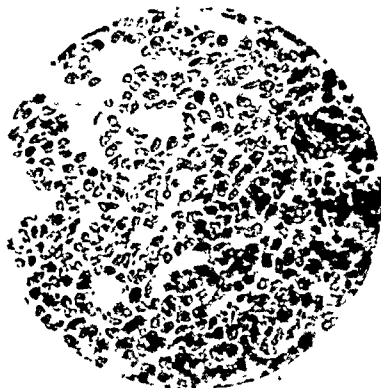


FIG. 5.—Photomicrograph of section through one of the most cellular areas in a mixed tumor of the parotid gland.

## BRANCHIOGENIC CARCINOMA

of the sternomastoid muscle and immediately below the ramus of the jaw. He had only noticed this lump two weeks before. Pain in the region of the growth was a very prominent symptom. I recommended immediate operation, which was accepted, after first having taken a few days to arrange his affairs. On August 2 I operated, removing the mass by a somewhat radical operation. The tumor proved to be an epidermoid carcinoma, and from its situation, and its freedom from epithelial structures, must have taken its origin from the second branchial cleft, from resting cells of fetal origin.

The tumor showed microscopical evidence of very rapid growth, in that the epithelium presented many mitotic figures, and the cancer cells having very little supporting connective tissue. It reoccurred within three weeks, and another surgeon operated on him after I had declined to undertake another operation for the recurrence, feeling it would do no good in the face of its wonderfully rapid development. This second operation was done October 20, less than three months after the first operation, and a little over three months since the first manifestation of the disease. He died on the operating table. No secondary manifestations had declared themselves. No postmortem was obtained.

No member of the family, or collateral branches, were ever known to have developed cancer. Nor did any member ever die under circumstances that would lead the physician to believe any of them had ever died of cancer, yet the cause of death was ascribed to some other disease. His father died at the age of seventy-six, from pneumonia; his mother at the age of seventy-five, from some sort of bronchial disturbance of ten years' duration. Of the six children, one died in infancy. The other four are living and well, all older than the patient under consideration. So, whatever was the cause of the cancer in this case, heredity did not manifestly play a part in its causation, without there had been a previous recession of hereditary features.

The diagnosis of branchiogenic carcinoma is not easy, nor indeed possible, in many cases before operation. Its location in the accepted region of the second branchial cleft, just below the jaw, and in front of the sternomastoid muscle, together with the fact that the tumor is beneath the deep fascia, and that the mass is hard and associated with pain, are all things that are helpful in determining the diagnosis.

One must make sure that the growth is primary and not secondary in character. It is easy to overlook some primary focus of infiltration.

Von Bergmann<sup>5</sup> pointed out three diseases which may be mistaken

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<sup>5</sup> Von Bergmann: Syst. Practical Surg., p. 120.

for branchiogenic carcinoma: "Lymphosarcoma, tuberculous lymphoma, and actinomycosis." Sarcoma is more apt to be soft on pressure than tuberculous glands, which may be quite hard on pressure. But both of these diseases are much freer from pain than branchiogenic carcinoma.

If a branchiogenic cyst has been present for a long time, and suddenly undergoes the change of showing a hard area, together with associated pain, suspicion should at once be aroused as to the probability of a carcinomatous growth having begun. The same author just quoted reports a case of this type having developed on a cyst wall. He has also made it clear to us that a cyst of the neck may have an entirely different origin than the branchiogenic cyst. Notably in this class are the congenital serous cysts. In discussing these cysts, von Bergmann continues: "These tumors develop by continual dilatation of the lymphatic vessels, as demonstrated by Koster in 1872, and later by Winiwarter and Wegner. They were called lymphangiectasia congenita (Koster) or lymphangioma cystoides (Wegner). The tumor consists of multiple cysts lined with epithelium, and contains a clear serous fluid that coagulates on standing."

Sebaceous cysts, dermoid cysts, blood cysts, and echinococcus cysts substantially complete the list of cysts of the neck, in addition to the ones already described.

Richardson<sup>6</sup> has pointed out some of the difficulties in diagnosing primary branchiogenic carcinoma in its likelihood of being confused with certain primary tumors in other situations, giving a secondary tumor in the neck by metastasis. He says: "Probably the most difficult are metastases from carcinoma of the parotid or submaxillary salivary glands. Primary tumors in other structures, thyroid, pharynx, larynx, carotid body, face, mouth, nasal cavity, tongue and more rarely œsophagus or even stomach with cervical metastases, must be considered and excluded if possible."

Many cases of branchiogenic carcinoma cannot be diagnosed in advance of operation, or postmortem; but usually one can arrive at a fairly accurate opinion of the type of the trouble if one carries in mind the many difficulties of diagnosis and secures a fairly accurate history of the case.

In making a differential diagnosis of branchiogenic carcinoma, one must always think of endothelioma. Wingrave<sup>7</sup> says that during the last year he has examined several growths, belonging to the tumors described as endotheliomata, removed from the cervical and parotid

<sup>6</sup> Richardson, Maurice L.: Cleveland Med. Jour., September, 1915, p. 583.

<sup>7</sup> Wingrave, Wyatt: A. M. A. Jour., vol. xlviii, 1907, p. 1281.

regions, and from the upper respiratory and digestive tracts. These tumors, he asserts, may be defined as neoplasms developed from the following type of epithelioid or mesothelioid cells, such as are found lining blood- and lymph-vessels. The tumors are also said to arise in vestigial structures, such as occur in connection with the branchial clefts on and in the intercarotid gland, probably from angioblastic elements.

Still, one must be careful to differentiate these endothelial tumors from certain other conditions, such as mixed tumors of the salivary glands and from tumors of the carotid body. It is only within recent years that tumors of the carotid gland have received much emphasis, and so some of the peritheliomatous growths of the older writers on tumors of the neck may in reality represent neoplasms of this organ.

Embryologically considered, the carotid body is a derivative of the chromaffin system. It has been confused as a derivative of the epithelial tissue arising from the third branchial cleft, but closer study has shown it to possess the peculiarly staining cells that are characteristic of the chromaffin group of cells.

Carotid tumors are frequently confused with other growths. Fee,<sup>8</sup> in speaking of carotid tumors, says: "Tumors of this gland are not easily diagnosed, as shown by the early reports. They have been mistaken for enlarged lymphatic glands, lipoma, and even goitre. In my own case, I had made a diagnosis of carcinoma of the thyroid gland."

In determining the prognosis, therefore, the exact location, the character of the structures involved, and the histological picture of the particular tumor under study must be given consideration. The histological study should determine the following points:

1. The presence of mitotic figures.
2. The degree of differentiation of the cells.
3. The extent of the invasion, *i.e.*, the study of the capsule, if there be one present.
4. The presence of tumor cells in the lymphatics or blood-vessels.

The prognosis of branchiogenic carcinomata is grave indeed. McKenty,<sup>9</sup> in reporting five cases having occurred during fifteen years in the Royal Victoria Hospital, Montreal, says: "The mortality was 100 per cent. This is partly due to the situation, where so many important structures are early involved, and also to the extreme malignancy of the tumor."

All writers are in accord with McKenty in the main, that the prognosis is at least very grave.

<sup>8</sup> Fee, Frank, M.D.: Johns Hopkins Bulletin, May, 1912, p. 146.

<sup>9</sup> McKenty, F. E., M.D.: Surg., Gyn. and Obs., August, 1914, p. 141.

## SUMMARY

1. The first branchial cleft is concerned in the formation of the external ear and the eustachian tube.

2. The tonsil is formed from the second gill-cleft, which, on failure to close, gives rise to either a fistula or cyst, from the walls of which a carcinoma may develop.

3. The thymus gland and the parathyroid bodies are formed from the third gill-cleft. When a cyst, fistula or carcinoma develops from the epithelial lining it will appear lower in the neck than similar disturbances arising from the second gill-cleft.

4. The rudimentary fourth gill-cleft, or the fifth arch, may give rise to a post-branchial growth.

5. Carcinomata may arise from embryonic epithelial inclusions of any of the gill-clefts.

6. When a cancer arises from the second cleft, it is situated just below the angle of the jaw and in front of, or just under, the sternomastoid muscle.

7. Tumors of the carotid body may develop which will require differentiation from gill-cleft carcinomata. In doing so, one should remember that the carotid body belongs to the chromaffin system.

8. Endotheliomata likewise require especial thoughtfulness in diagnosing, which can be done only when the morphological cell structure is studied.

9. A common source of error, preceding operation, is to mistake these various neck conditions for enlarged lymphatic nodes.

10. When a branchiogenic cyst has been in existence for some time, it is not unusual for a carcinoma to develop on the wall of the cyst.

11. Lymphangioma, sarcoma, cystic goitre and secondary carcinoma of the lymph-nodes, or other structures, are to be thought of in making a differential diagnosis.

12. When a cyst appears in the middle of the neck, above the thyroid, it is probably from an unclosed foramen cæcum, from which the thyroid gland is developed.

13. If a branchiogenic carcinoma is glandular in type, it has been derived from embryonic inclusions of epithelium derived from the infolding of the entoderm forming the inner clefts; if squamous celled, it is derived from either entoderm or ectoderm.

# BRANCHIOGENIC CARCINOMA

## CONCLUSIONS

1. The mortality of branchiogenic carcinomata is very high. This is probably quite as much due to the start it gets before operation, owing to its deep seat, rendering diagnosis so difficult, as to any extreme malignancy of the growth, although this is sometimes very great.

2. In rapidly growing branchiogenic carcinomata, the cell differentiation may be so imperfect in many fields as to simulate tumors of endothelial origin. Other fields usually clear up this uncertainty.

3. Operations for the relief of branchiogenic carcinomata are always serious, owing to their attachment to deeper structures, which may require removal. Both the carotid artery and jugular vein may be injured to an extent requiring the removal of a section; the pneumogastric nerve may be injured at the same time.

4. The only hope for making any satisfactory reduction in the mortality rate following operations for branchiogenic carcinomata is to operate earlier in their progress.

5. Any hard swelling in the region of the branchiogenic clefts should immediately arouse suspicion of branchiogenic carcinoma, especially if associated with pain as a prominent symptom.

# THE THERAPEUTICS OF CHRONIC NON-TUBERCULOUS SUPPURATIVE BRONCHIECTASIS \*

BY HOWARD LILIENTHAL, M.D.

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BEFORE this assembly it is not necessary to enumerate and discuss the various forms of pulmonary non-tuberculous purulent infection. To do so would take up most of the evening and would probably contribute nothing new to your knowledge. Garré and Quincke,<sup>1</sup> Lord,<sup>2</sup> and a number of others, have dealt exhaustively with this subject.

I wish to confine myself to the sad cases of those patients who, having tried the best that medicine affords, are left to look forward to a future of cough and foul expectoration, to periodical attacks of septic fever, to the repeated terror of pulmonary hemorrhages—and to the heart-breaking disappointment of an unproductive life.

The most frequent form of this disease may be considered primarily bronchiectatic in character, though later the cavities, perhaps never entirely free from some mucous membrane lining, become more nearly like true abscesses with indurated cicatricial walls whose rigidity, even in the absence of pleural adhesions, would resist all possible gas compression therapy.

While the actual mechanical causes of bronchiectatic dilatations can only be surmised, it is known that the disease may follow almost any bronchial infection, whether occurring originally within the tube or coming from the surrounding parts—lung, abdomen, pleura, rib. Certainly, it seems as if in some instances the dilatation were due to septic destruction or weakening of the bronchial wall.

The long-continued presence of a foreign body in the bronchus will almost invariably cause suppurative bronchiectasis.

At a recent meeting of the New York Academy of Medicine, Llewellys Barker<sup>11</sup> stated that a certain number of these cases were of syphilitic origin and amenable to antiluetic treatment, a most interesting and important observation. In my service at Mt. Sinai Hospital it has been our custom to make blood tests in all these cases. Thus far none has shown the presence of lues, and but one patient in private practice gave a history of the infection.

Postoperative bronchiectasis following tonsillectomy and removal

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\* Read before the Chicago Medical Society, March 29, 1916.

of adenoids, in *general anæsthesia*, and particularly in adults, has been exemplified in eight cases within a few months at Mt. Sinai Hospital. Wessler<sup>3</sup> says that 28 per cent. of all lung suppurations coming to the radiographic department of Mt. Sinai Hospital followed operations of this character. While most of these patients recovered spontaneously or under hygienic and supportive treatment, some were medically hopeless and could be relieved or cured by surgery only.

In a paper read by Manges before the Laryngological Section of the New York Academy of Medicine on January 26, 1916,<sup>4</sup> he dwelt upon this sequel of tonsillectomy. In the free and warm discussion which followed various opinions were advanced. Yankauer believed that much of the blame was to be laid upon insufficient preparation for the operation, a fault too common in hospitals. This resulted in the vomiting of food during the operation and in the aspiration of foreign particles. He believed that operating with a continuous suction tube in the pharynx would eliminate the danger of aspiration of blood and of the septic material pressed from the tonsil during tonsillectomy. Coakley, because of the freedom from such complications following his operations in which general anæsthesia was employed without suction, regarded the anæsthetic as having no important relation to lung abscess of this variety. He called attention to Scudder's reports of lung abscess<sup>5</sup> which followed other than throat operations.

Others present blamed unskilful sponging and swabbing, which plugged the throat at the time of inspiration.<sup>6</sup>

The writer, who took part in this discussion, was convinced that the aspiration of septic matter, or bits of tissue from the tonsils or adenoids, caused localized bronchiectasis or bronchopneumonia with subsequent abscess formation, and that such aspiration was much more liable to occur because of the absence of reflexes in full narcosis than in operations performed with the aid of local anæsthesia. He also went so far as to advance the suggestion that in children too young for a radical operation without narcosis the diseased tonsils should be treated by tonsillotomy without anæsthesia, and that the radical operation should be postponed until early adult life, when local anæsthesia could be employed. This general rule may be broken in cases of exceptional urgency, but in any event continuous suction during the operation should not be omitted.

The argument may be advanced that every mouth contains patho-

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<sup>6</sup> A. N. Strouse, of New York, in a personal communication, stated that much of this danger could be averted by preparing the tonsils some days before tonsillectomy; pressing out plugs and disinfecting crypts and follicles.



genic germs, yet that suppurative lung infections are rare after surgical work in distant parts of the body, even in narcosis. But it must be remembered that pneumococcus infections in these circumstances<sup>6</sup> are not uncommon, while abscesses are rare. Also, that the enormous implantation which could easily follow the aspiration of the contents of diseased tonsil follicles might kindle a suppurating infection which the mere aspiration of slightly infected mucus and saliva would not accomplish.

*Diagnosis of Chronic Lung Suppuration.*—The most important sign of this disease is the cough with easily-raised, profuse, mucopurulent sputum, and with complete remissions of from several hours to one or more days. As a rule, the discharge is foul, though there may be two or more kinds of sputum from cavities in the lungs of the same individual, some with fetor, some without much odor. The pungent, penetrating stench of acute gangrene, is, however, absent. The quantity varies, but 500 c.c. or more may be coughed up in twenty-four hours.

Even in this non-tuberculous disease elastic fibres are often found. The flora of the cavities is abundant and varied.

When the cavity fills with secretion, there may be irregular elevations of temperature which recede with the drainage accomplished by the periodic emptyings.

The general nutrition of the patient may not be impaired, though this depends largely upon the degree of sepsis. The fingers, however, become characteristically clubbed, and this deformity may vanish with the cure of the disease (Figs. 4a and 4b).

The physical signs are too well known to require reiteration here, but the X-ray will frequently show changes not clearly demonstrable by the older methods. Even with the X-ray, one cannot invariably make close differentiation. The radiograph must be taken with the history and with that most important recent diagnostic acquisition, the bronchoscope.

In estimating the character and extent of the infection it is highly advisable to make an examination with this instrument. It may establish the presence of dilated bronchi and it can show in which lobe of the lung lies the source of the discharge. Unsuspected and radio-transparent foreign bodies may be extracted, with consequent cure of the disease. New growths may be grossly diagnosed and specimens removed for microscopical examination.

Irrigation of the cavities has been practised by Yankauer with the aid of one of his ingenious devices, which washes without drowning. Relief for several days may follow this procedure, and it may be found useful as a pre-operative measure.

## THERAPEUTICS OF SUPPURATIVE BRONCHIECTASIS

*Treatment.*—General treatment by medical means is justifiable if guided by the clinical course of the case and by the radiograph; but when, after months of conscientious work, it becomes clear that failure is inevitable, no more unnecessary time should be lost in a therapy which, after all, amounts to little more than simple observation. A surgical consultation should be held and a conclusion reached as to the suitability of operation for the case in hand. The location and the anatomical distribution of the lesions, as shown by X-ray and bronchoscope, are of the greatest importance. In the present state of surgery advanced bilateral chronic pulmonary infection should forbid radical operation and the surgeon should decide whether, even in a unilateral case, the disease may not perhaps be too far advanced.

The functional condition of the other vital organs and any coexisting pathology which might prejudice the result must be considered.

And here it may be well to sound a warning against the pernicious practice of diagnostic puncture before the actual time of operation, radical or exploratory. Puncture cannot do good and it may result in the most serious complications. It may be a delicate matter to bring home to the physician this important fact. The medical man may be averse to turning his patient over to the surgeon—unfortunately often regarded as a mere operator—until the diagnosis has been made with the greatest possible accuracy.

This “refinement,” however, is quite unnecessary, to say the least, and it has a direct mortality from the occasional unavoidable injury of blood-vessels and nerve trunks, not to speak of infections of the pleural sac.

Now, let us imagine that a case of bronchiectatic lung suppuration has gone on for six months with no sign pointing toward a healing process, and with the short remissions which only accentuate the misery of the patient. Let us also suppose that the X-ray and bronchoscope point to a localization in a single lobe with little or no involvement of the opposite lung. This would, then, be a case suitable for the radical extirpation of the infected part. To wait longer would probably subject the patient to the danger of extension of the process in the same lung, or even to the opposite chest, with the establishment of an incurable condition.

Palliative operations are almost or quite as dangerous as extirpation, and the improvement is rarely such as to enable the patient to go about his work as he did before his illness. Often scoliosis from multiple rib resections makes the patient an incurable cripple.

Extirpation, while surely a capital and a dangerous procedure, does

hold out the hope of actual cure. The gravity of the procedure must be explained to the friends or family, but in discussing the case with the patient only the hope of a restoration to complete health should be dwelt upon.

In the early days of operating for appendicitis, cholecystitis, and many other surgical conditions, we began with the most hopeless cases, gradually winning our way until we arrived at the present gratifying stage, when early diagnosis is followed by prompt and successful surgery. So for the present we must be satisfied to operate in the *worst* and most hopeless cases of lung suppuration, where there is little to lose and much to gain. Later, with improvement in the technic, we may find that lung surgery is no different from other surgery and that we shall operate in the early cases with greater promise of cure. The fact that some lung abscesses get well without operation may be misleading. Appendicitis—even intussusception—may disappear spontaneously, yet that is a poor argument for withholding operation. A patient recovered from a well-established condition of suppurative bronchiectasis or chronic lung abscess must be watched for a long time before he may be pronounced well.

After a fairly wide experience,<sup>7</sup> amounting in all to more than twenty-six cases since 1910, I am convinced that palliative treatment should be reserved for actually hopeless cases, such as those of bilateral involvement or those in which the condition in one lung is so extensive and complicated by adhesions that extirpation is clearly impossible.

A single focus, or multiple foci in one lobe, should be removed surgically. And even when an abscess has extended so as to implicate neighboring lobes in one single infected mass, it has been shown that extirpation may be successfully performed (Cases III and V).<sup>b</sup>

*Methods of Procedure.*—The method which I have employed in my radical operation for lung suppuration differs materially from that which has been generally described and adopted. Although my cases are few, the results do not suffer by comparison with the published records of others. The work is so new that, if eventually we are to evolve a satisfactory technic in these difficult cases, each of us must contribute by recording his experiences whether the results are good or bad.

First, then, as to the preparation of the patient. If the case is one in which posture will cause a partial or complete emptying of the cavities, the patient, during the twenty-four hours preceding the operation,

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<sup>b</sup> Lenhartz <sup>12</sup> evidently errs in limiting the indications for resection to cases in which but one lobe is diseased.

should free his lungs of as much secretion as possible. About one hour before the operation a dose of morphine and atropine is given, as much for its quieting effect upon the mind as an aid to anæsthesia. Before administering the anæsthetic, the thighs close to the body are compressed with ligatures or, better, rubber bandages, so as to cut off the venous return and segregate as much blood as possible in the lower extremities, which should become deeply cyanosed. This method, employed by the late Dr. A. L. Loomis in the treatment of hæmoptysis, was revived by the late Dr. Dawbarn as a preliminary to bloody operations. I have made experiments which demonstrate that the blood-pressure may be reduced as much as 60 points by this means. When the ligatures are removed the normal pressure is not reëstablished for from 30 to 60 minutes. Permitting the blood to flow back after the operation has much the same effect as a transfusion with unetherized blood, so that the patient quickly recovers from the narcosis.<sup>c</sup>

Ether has been very sparingly used, although sometimes it is necessary to resort to it in the beginning, until unconsciousness has been established, when we proceed with nitrous oxide and oxygen. Team work of anæsthetist and operator is essential, and this can best be secured by working regularly with the same anæsthetist. He will learn to understand the operator, and the surgeon, with increasing confidence, will not have his attention divided between the operation and the anæsthesia. If ether is to be used at all some sort of insufflation apparatus is indispensable.

Early in my work I was convinced by Dr. Branower, one of my anæsthetists, that the intrapharyngeal method had advantages over any other with which I had experience. Pressure is never so great as to cause apnœa, quiet respiratory movements going on constantly; yet the pressure may be increased sufficiently to distend the lung to any required degree by the simple expedient of closing the mouth of the patient. Although I have employed the intratracheal insufflation method from the first and, in fact, in the very first case in a human being in which this method was employed,<sup>d</sup> I have concluded that in operations upon one lung the intrapharyngeal method is safer and easier of application; also, since natural movements of inspiration and expiration occur, the theoretical danger that septic material may be blown from the throat into the

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<sup>c</sup>This method of reducing blood-pressure is of value in hemorrhage from any other causes—typhoid intestinal bleeding, gastric hemorrhage, etc.

<sup>d</sup>NOTE—If nitrous oxide and oxygen are employed, there will be a sufficient blowing force as the gases are liberated from their containers.

healthy lung may be disregarded.\* I am well aware that in making this statement I have but little material on which to base my conclusion, and would reserve the right to alter my opinion with further experience.

*Position of the Patient.*—The subject should lie upon the healthy side or a little over towards the prone posture. With intrapharyngeal insufflation there is little if any danger of embarrassment of respiration. It is at times convenient to raise the head of the table, either at the beginning or during the operation, if access to the thoracic cavity seems to be aided thereby.

In all my cases disinfection of the skin was secured by the iodine method.

*The Incision.*—In operation on the lower or middle lobe an incision in the seventh or eighth interspace, beginning at the angle of the ribs and running forward to the anterior axillary line, or even farther, will give free exposure. The line of incision should be near the upper border of the lower rib so as to keep away from the intercostal vascular structures. I have not had the opportunity to resect an upper lobe. Having divided the muscles down to the endothoracic fascia, the ribs are separated with blunt retractors and the pleura incised with great care so as to avoid the unintentional wounding of a possibly adherent lung. I have usually entered the pleura near the posterior end of my incision and, inserting the finger, have quickly enlarged the opening forward with scissors. The rib-spreading retractor is now adjusted and the ribs are slowly forced apart.

If, in spite of a long incision, the ribs cannot be separated sufficiently for easy access, or if the selected interspace proves, on exploration, to be too high or too low, costotomy of one or more adjoining ribs, at either end of the wound, above or below the incision, will give ample room.

Inspection will now reveal the dusky red diseased part in strong contrast to the normal lung, and the observation will be confirmed by palpation.

Adhesions between the lung and parietal pleura are nearly always present and the mobilization of the focus of infection must be managed with caution. Oozing hemorrhage is apt to follow the peeling away of membranous adhesions, while the more massive or cord-like ones often contain vessels which require ligation.

Before dividing any adhesion, whether bluntly or by dissection, one must be sure that there is an easy approach to any point of possible

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\* In three cases of cesophageal intrathoracic surgery this intrapharyngeal method gave perfect satisfaction. In one of these operations there was a large opening into the right pleural sac through the opened left chest, yet no untoward symptoms developed.

hemorrhage, for the expedient of pressure packing with gauze is hardly available in endothoracic surgery.

The diseased part of the lung once freed from its adhesions to the chest wall, it will probably be necessary to isolate it from an adjacent healthy lobe. This may be done bluntly or with dissecting scissors. Compression or rough handling of the abscess is dangerous, for partially-eroded vessels of great size may be torn through, with almost instant death.

Adhesions between the uninvolved lobes and the chest wall should not be disturbed. Their presence is a safeguard against the collapse of the lung and also against the dangerous so-called "fluttering" of the mediastinum.

In removing an entire lobe the question of the greatest importance is the treatment of the structures at the hilum. Garré and Quincke, Meyer<sup>9</sup> and others have advised that the vessels be isolated from the bronchus and secured by individual ligation, the bronchus itself being crushed and ligated and the stump inverted and buried. We are warned that this stump must be held by suture to the surrounding parts to prevent its withdrawal into the mediastinum, with the subsequent formation of pneumomediastinum in case of air leakage. In resection of the lung for non-inflammatory conditions, such as tumors, and in experimental work on normal animals, this method, followed by closure of the wound in the chest wall, is probably feasible; but in these infected cases I have found the structures of the hilum matted together by the organized plastic products of inflammation so that dissection has appeared to me laborious, time-consuming and perilous. I, therefore, have proceeded by crushing the entire pedicle with a powerful clamp, which was then removed and the crushed pedicle secured with chain ligatures of strong chromicized catgut. Now, cutting away the lobe, the vessels were separately secured beyond the ligature and the bronchial stumps carbolized, and also once more tied, but with no attempt to invert.

If there are no adhesions between the remaining lobes of the lung and the chest wall, it will be necessary to fix the stump in such a way as to prevent flapping of the mediastinum. I have done this by placing a suture or transfixion ligature through the stump, distal to the main ligature, and fastening it not too tensely to the chest wall entirely outside the wound. Leaving the two ends long, tying them together, and running a safety-pin through the loop, the pin is fixed outside the wound, but dangerous traction is to be avoided. Very little force is sufficient to steady the flapping mediastinum. If there are massive adhesions between the remainder of the lung and the chest wall this ligature will

not be necessary, although its application is not an unwise precaution.<sup>f</sup> A single packing of gauze is laid against the stump and led out of the wound.

The spreader being now removed, a few chromicized catgut sutures through the muscles will approximate the ribs sufficiently without pericostal or percostal sutures, and the skin may be closed with silk, leaving draining space for the ligature which supports the mediastinum and for the gauze.

Believing it to be quite hopeless to try to prevent infection in these cases, I have accepted the inevitable and merely provided for ample drainage. The dressing consists of gauze padding, held in place with adhesive straps which confine the diseased side only, no turn of bandage encircling the body. Respirations are kept down with morphine.

Convalescence is pretty sure to be stormy. For the first few days there is a seropurulent discharge, and it may even be necessary to insert a tube alongside the gauze. The ribs will remain separated an inch and a half or more, gradually approaching each other, for from five to ten days. The slough of the stump will come away in due time, and in three of my cases there was a temporary bronchial fistula, the opening, naturally, far from the chest wall. This seems to close of itself as the diaphragm rises and the remainder of the lung expands and the cavity becomes obliterated. Indeed, I am not sure that the open bronchus may not be a temporary advantage because of the drainage afforded during the healing of the lung.

If a free discharge of pus occurs during the convalescence, I have used a graduated suction apparatus of about six inches of mercury, not only to remove the discharges, but because I believe the drying out of the wound by the current of air stimulates granulation and promotes healing. The apparatus used in my cases was made by Sorensen of New York.

My cases have all shown tachycardia after the operation, but this is a symptom which is frequently present before surgical intervention, often persisting for months.

The technic here described must be modified according to the case. For example, when I have removed a diseased focus by resecting a part of a lobe, or even a part of three lobes (Case 3) in one piece, I have

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<sup>f</sup> The mediastinal flapping is caused by the respiratory efforts of the healthy side, which draw the soft mediastinal tissues toward the sound side on inspiratory movements, bulging them toward the opened side on expiration or on pressure with the closed glottis. As long ago as 1887, C. Bayer<sup>10</sup> devised the method of pneumopexy to steady the mediastinum during thoracic operations.

## THERAPEUTICS OF SUPPURATIVE BRONCHIECTASIS

done it by crushing the healthy lung beyond the abscess and placing chain ligatures of chromicized catgut in the crushed area, crushing only a little at a time, ligating and then proceeding to the adjacent part successively, until finally the entire focus is surrounded by chain ligatures. The abscess is then cut away through infected tissue, which will later be cast off. The stump, no matter how large, is thoroughly carbolyzed with applications of 95 per cent. phenol.

I am aware that this procedure makes but little attempt at surgical asepsis. But when it is recognized how difficult it is to prevent infection of the free pleural cavity, in the presence of even the smallest amount of septic matter, it appears to me far safer to admit the conditions as they are and provide for the infection when it arises. I have carefully considered the possibility of operating in two stages, and perhaps some safe method of accomplishing this may be devised. Up to the present I can conceive of no two-stage procedure which would not also involve the formation of adhesions, and in thoracic work these are more difficult to deal with than in the surgery of any other part.

In forty-eight hours gauze packings in the clean pleura are so firmly adherent that great force is necessary to withdraw them. Perhaps surrounding the lung with rubber dam between the stages may prove effective.

When the wound has become simplified, but healing is slow, I have found that the injection of 5 per cent. iodoformized vaseline stimulates repair and greatly reduces the quantity of discharge.

The barrel of a large-nozzled glass syringe may be filled with the ointment after removing the piston; then, replacing the piston, the vaseline in its natural state—not liquid—can easily be forced from the nozzle.

Iodine or other irritants must not be injected into these cavities for fear of their entering a bronchus. An alarming spasm of coughing may result.

The writer has found full open-air treatment of the greatest benefit, the change in the appearance and general behavior of the patients being most striking, even after but a few days and nights in the open.

When the wound has healed there must still be a period of careful observation. Active exercise had better be forbidden for a number of months and a tendency to cough treated with small regular doses of opiate, preferably heroin or codeine, for severe coughing is apt to force a reopening of the wound.

Two short tables accompany this paper, and there are also the reports of seven cases in which extirpation was performed or attempted.



Of the six cases in which the operation could be completed there were four cures.

One patient, whose case was badly chosen for extirpation, died as the result of an exploratory operation.

But compare this with the report of twelve drainage or "conservation" operations, with but one cure, five so-called "improvements," which were merely a modification of the degree of invalidism, and six deaths. Surely this speaks clearly for "radical" surgery.

Probably in no disease is restoration to health more deeply appreciated than in chronic pulmonary suppuration. The surgeon will have an anxious time and there will be weeks and months of unremitting, conscientious work; but to bring one of these wretched outcasts back to happy, useful life, carries with it a reward the like of which is offered in no profession but that of medicine.

*CASE I.—Bronchiectasis of Entire Right Lower Lobe. Lobectomy. Cure.*

Francis W., a little boy, three years and nine months old, was referred to me by Dr. Yankauer, who had been treating him bronchoscopically for the extraction of foreign bodies—pieces of nut which he had aspirated into his lung a year before. There had been cough, expectoration and fever. The temperature ran in irregular waves, often reaching as high as 105 degrees. The bronchoscope had demonstrated abnormal secretions from the right lower lobe. The X-ray showed a general opacity at the right base, extending up to the eighth rib (Fig. 1).

First operation, Tuffier's Living Fat Implantation: On January 23, 1914, the tube for intratracheal anæsthesia was put in, but it was too large, so it was removed and anæsthesia continued by the intrapharyngeal method. Long incision between eighth and ninth ribs down to, but not through, the pleura. Pleura dissected away from the endothoracic fascia and a part of the ninth rib resected to make room for the finger, so as to continue the pleural separation. Three pieces of fat from the abdominal wall of another patient were utilized to fill a cavity large enough to contain about forty cubic centimetres. Wound closed without drainage.

The patient was not improved, and it was hardly to be expected with so small an implantation. A minute extrapleural sinus persisted. Second operation on February 27, 1914. Intrapharyngeal ether anæsthesia by Dr. Branower. Long seventh space incision into the pleura. The fat which had been transplanted was alive and in position. The lower lobe of the lung was



FIG. 1a.—Case I. F. W., before operation. Note opacity corresponding to right lower lobe.

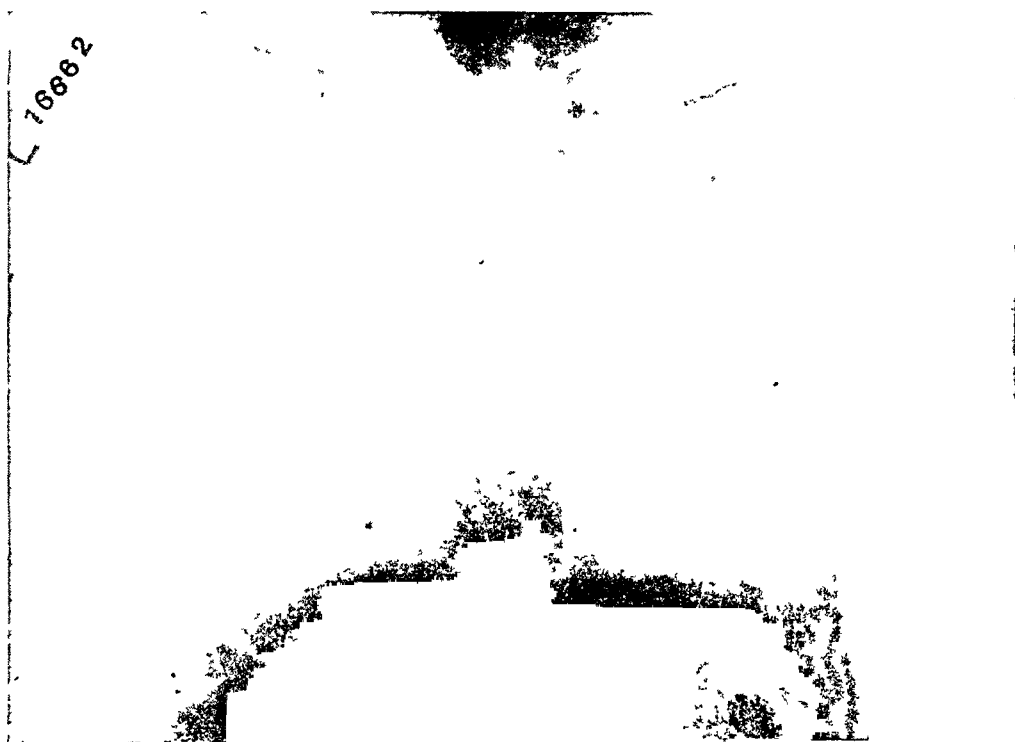


FIG. 1b.—Same case, about a year after operation. Chest almost normal.

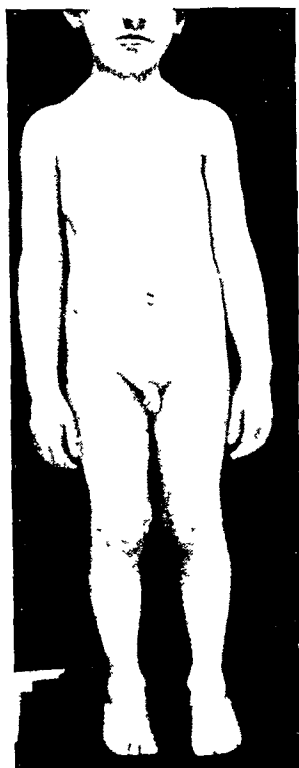


FIG. 2.—Case I. F. W., two years after excision of lower lobe of right lung. Note symmetry of development.

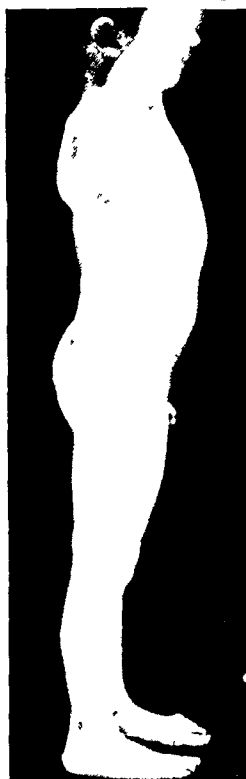


FIG. 3.—Case I. F. W., same date as Fig. 2. Note freedom of shoulder function



a



b

FIGS. 4a and 4b.—Hand of F. W. (Case I) soon after operation and at expiration of a year.



FIG. 5.—Case III. David J., before operation. Shadow represents disease of middle lobe with involvement of adjacent part of upper and lower lobes.

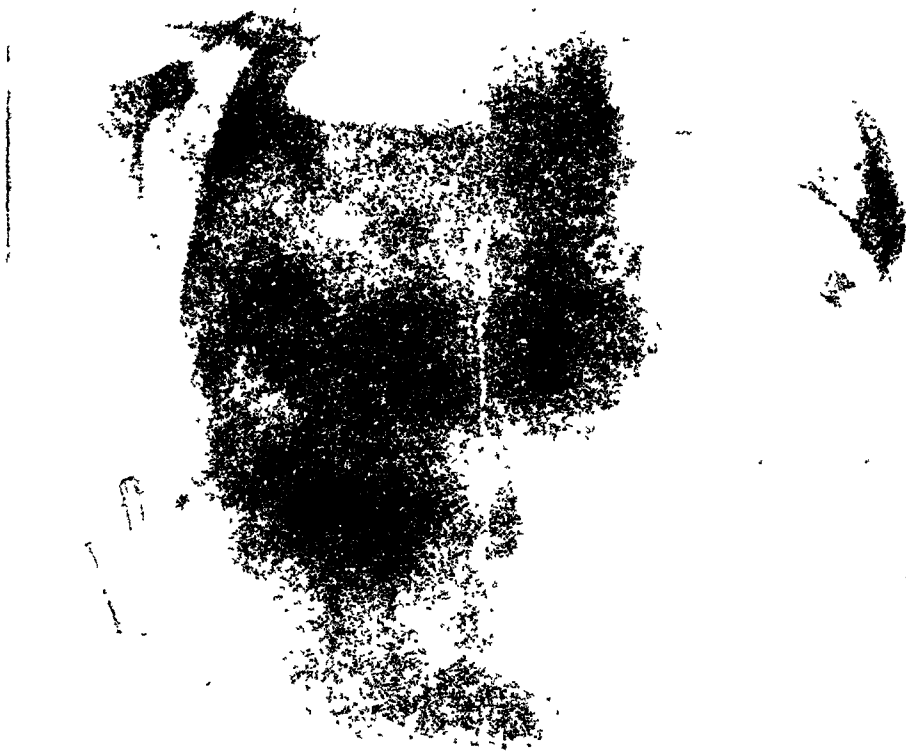


FIG. 6.—Case III. David J., post-operative sacculated empyema. Note fluid level with air above.

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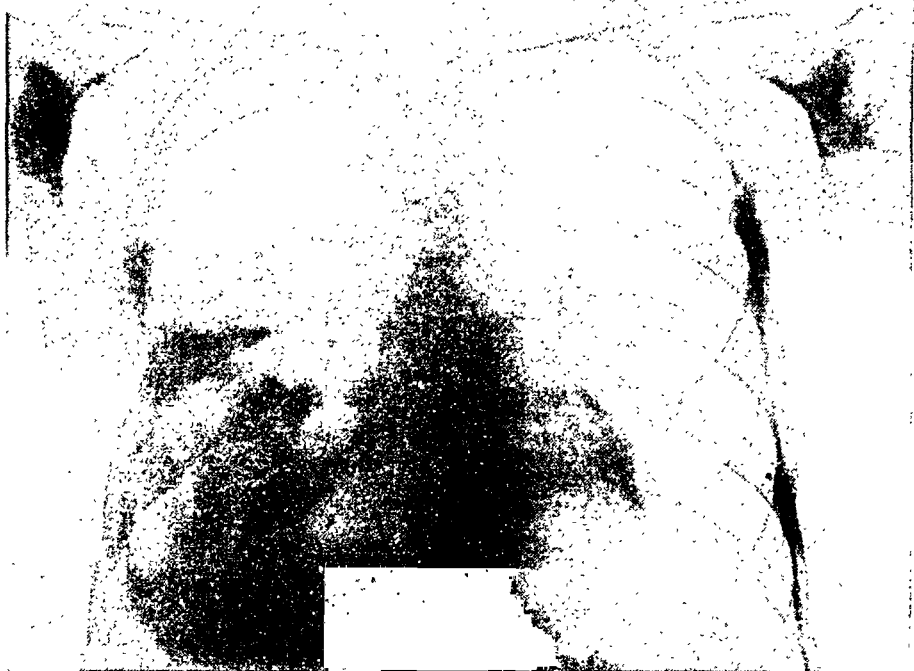


FIG. 7.—Case III. David J., ten months after operation.



FIG. 8.—Case III. David J., eleven months after operation. Resection of middle lobe and adjacent portions of upper and lower lobes.



FIG. 9.—Case III. David J. Note physical development and good function of shoulders.

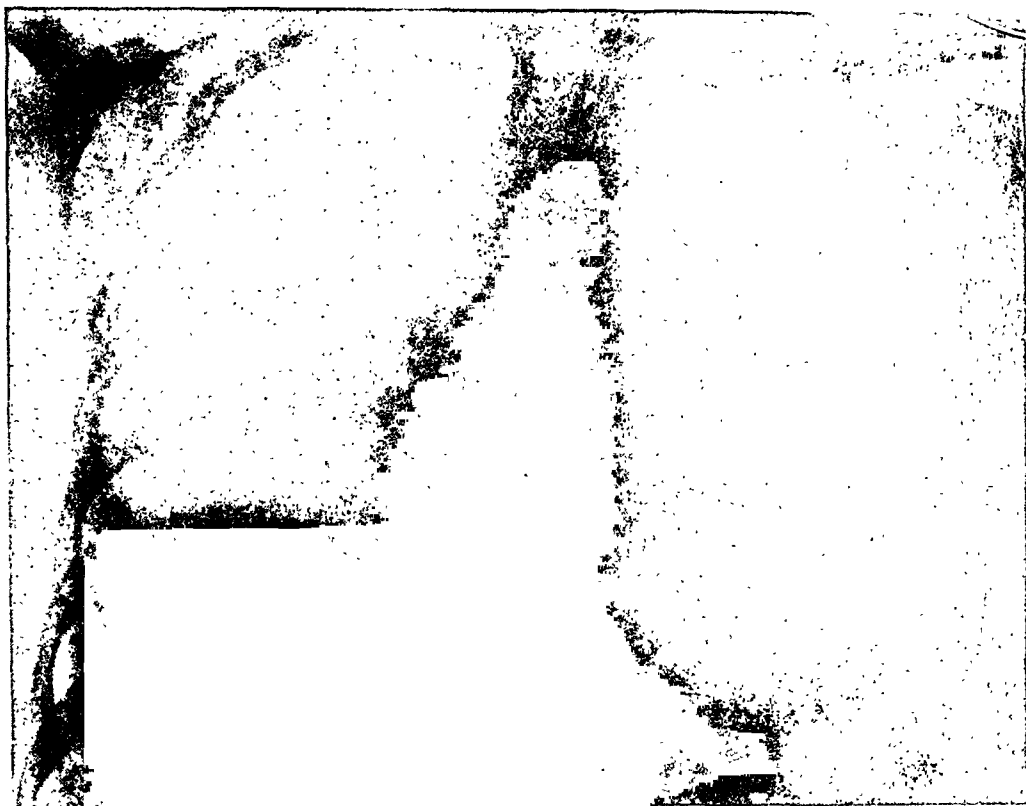


FIG. 10a.—Case IV. Lawrence F., before operation. Note shadow representing diseased lower lobe of right lung.

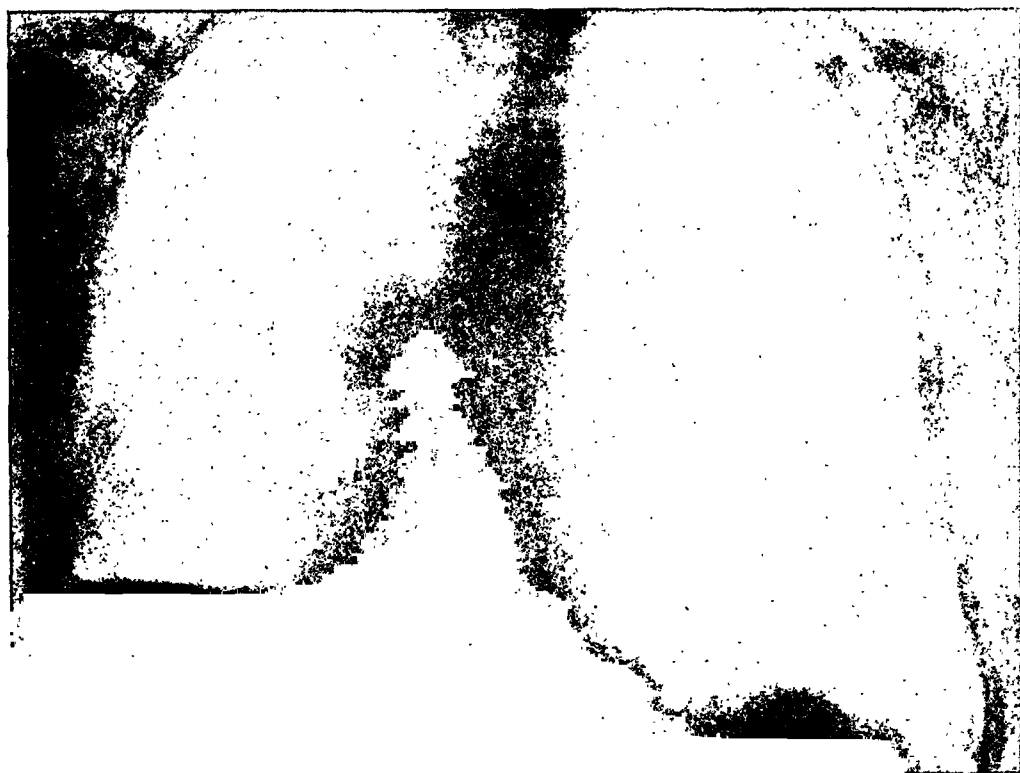


FIG. 10b.—Same patient as Fig. 10a. Eight months after lobectomy. The horizontal shadow limit represents the diaphragm in full inspiration.

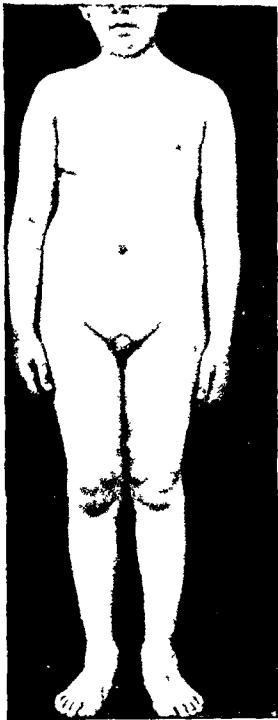


FIG. 11.—Case IV. Lawrence F., after recovery. Note symmetry.

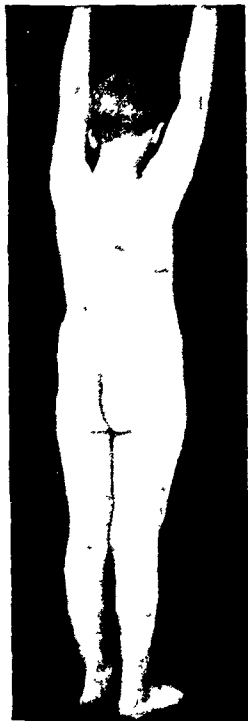


FIG. 12.—Lawrence F., illustrating perfection of shoulder function.

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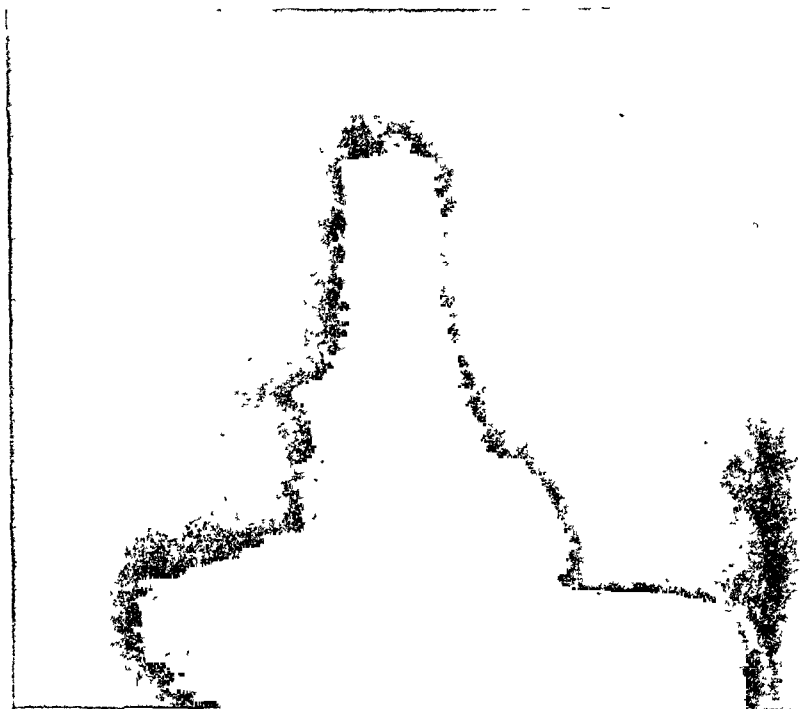


FIG. 13.—Case V. Mrs. B. Shadow represents bronchiectatic abscess of middle lobe.

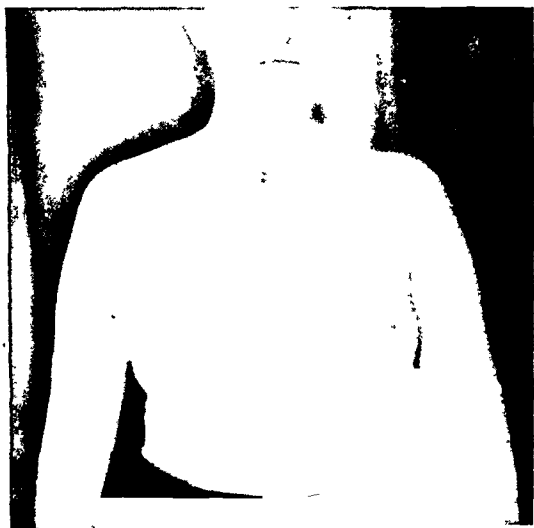


FIG. 14.—Case V. Mrs. B., four months after extirpation of middle lobe bronchiectasis. Slight atrophy of right deltoid from disuse.



FIG. 15.—Same patient as in Fig. 14. Note extent of cicatrix. This patient could not actively raise the shoulder beyond the angle here shown. The function, however, was rapidly improving.

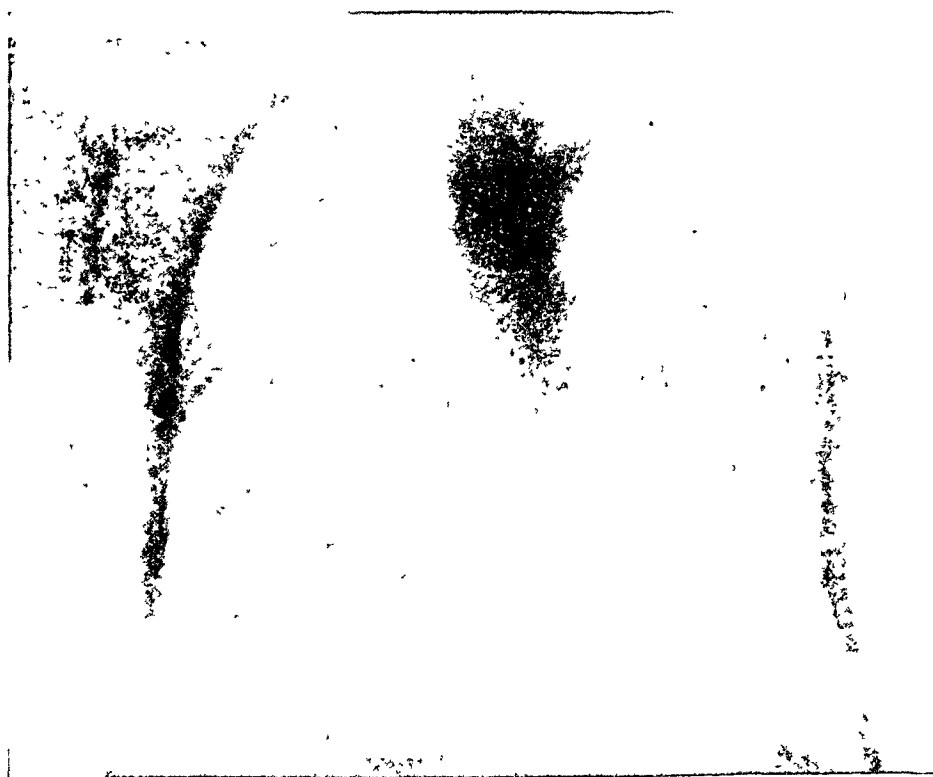


FIG. 16.—Case VII. Joseph S. Note shadows representing diseased right lower lobe and its adhesions to chest wall. The shadow in left chest shows some consolidation. This patient should not have been operated upon.





obviously the seat of the disease, the other two lobes being apparently normal, except for a few adhesions, and moving freely on respiration. The lower lobe, the color of liver, was of a firm consistency, and was adherent to the diaphragm and to the thoracic wall. All adhesions freed digitally, and a double ligature of chromicized catgut placed completely around the previously crushed hilum of the lower lobe. The lung was now cut away, and a slight oozing from the stump led me to transfix once more and to ligate double again. The stump was then carbolyzed and the thoracic cavity filled with saline solution. A piece of gauze was placed against the raw surface of the stump and led out of the posterior angle of the wound; another little piece of gauze was placed in the original sinus, the ribs approximated with chromicized catgut, and one Pagenstecher suture placed so as to embrace the two ribs adjacent to the incision. At the end of the operation, which lasted a half hour, the patient's pulse was about 150, but of good quality. His color had been cyanotic during the greater part of the operation, but now became pink. In less than an hour after the operation the child was awake and crying. Hemorrhage had not been severe, and what there was came from the adhesions.

A careful examination of the lobe which had been cut away showed that all the bronchi were dilated and had turned into what might be called abscess cavities. No foreign body was found.

Twenty-four hours after the operation the temperature rose to 103 degrees and the patient looked very ill, the pulse running to 200. Skin sutures were removed because of superficial suppuration. The gauze at the posterior angle of the wound was now loosened and there was a discharge of turbid fluid, probably salt solution with pus. Tube drainage now instituted. Continuous suction apparatus used. The slough representing the hilum came away on March 16, and there was at no time a bronchial fistula. With good nursing this patient gradually improved and was discharged well on April 17. The child has remained perfectly well and has developed normally. There is no scoliosis, but perfect symmetry (see Figs. 2 and 3).

CASE II.—*Bronchiectatic Lung Abscess. Attempted Extirpation. Death.*

Jacob S., thirty-six years old, was admitted to Mt. Sinai Hospital on June 2, 1914.

Twenty-eight years before he had had pneumonia. Twelve years before his appendix had been removed. Five years before he had had malaria, and two years before he had been operated upon for right lung abscess.

The present illness consisted in pain in the right chest, copious expectoration of foul sputum, fever, night-sweats, vomiting. All

these symptoms for more than six years. Two years before he had had a thoracotomy, with removal of the sixth, seventh and eighth ribs. No relief.

Physical examination showed signs of cavity in the chest, clubbed fingers, cyanosis, rapid pulse.

Urine contained a trace of albumin and a few white blood-cells.

On admission his temperature was 101.2 degrees. Pulse, 96. Respiration, 24. The temperature depended largely upon the patient's ability to empty the abscess by coughing. At times he ejected as much as twenty ounces of sputum in a single day.

The X-ray showed an extensive involvement of the right lower lobe and a portion of the upper lobe.

On June 8, 1914, bronchoscopy was performed by Dr. Yankauer and the abscess pretty well emptied, with reduction of temperature and some subjective improvement. No foreign body was found, but the bronchi were enormously dilated.

On June 11, 1914, in intratracheal anæsthesia with ether, an attempt was made to extirpate the diseased part of the lung. Long incision in the sixth interspace, rib spreader put in. Dense adhesions everywhere, so it was with great difficulty that I finally succeeded in entering the free pleural cavity, even at this high level. The patient's condition being good and the markings between the lobes of the lung being absolutely obliterated on account of adhesions and thickened pleura, an attempt was made to isolate the diseased part by peeling it away from the parietes. This proved to be impossible, and then an attempt was made to isolate the diseased portion by means of ligation through the apparently healthy lung. During this process, however, although he had not lost much blood, and although the lung was kept well fixed to avoid fluttering of the diaphragm (which, indeed, could hardly have occurred on account of the dense adhesions), the patient suddenly collapsed and the operation had to be stopped. We had taken the precaution to segregate the blood in the patient's lower extremities by means of elastic ligatures about the upper part of the thighs. These were at once hastily cut away, letting the blood in from the legs, and the patient also received twenty ounces of saline solution intravenously, with a few drops of adrenalin. He revived, the pulse improved, and he was able to respond to questions. About an hour and a half after the operation, however, he died.

I think it is quite possible that oozing from the abscess cavity, which had been entered during the operation, was instrumental in his final taking off. I was at work over another patient when word came that this patient was bleeding. My house surgeon at

once reopened the wound and packed the abscess cavity from which he stated the bleeding came.

This case suggests the importance of recognizing an inoperable case after the chest is opened. Had we then satisfied ourselves with rib resection directly over the abscess, with evacuation and packing of the cavity, the operative death might perhaps have been avoided, though the patient would not have been cured.

CASE III.—*Bronchiectatic Lung Abscess. Resection of Right Middle Lobe and Part of Two Adjoining Lobes. Cure.*

David J., sixteen years old, was admitted to the medical service of Dr. Manges, at Sinai Hospital, on December 2, 1914.

Six months before admission he began to cough and expectorate. The cough and quantity of sputum gradually increased until large amounts of greenish and sometimes blood-streaked mucopus were expelled. He usually emptied his suppurating focus in the morning. There was pain in the right chest. A loss of fifteen pounds in weight.

Physical examination showed on the right side anteriorly from the first to the third space, dulness, and below, flatness. Bronchial breathing over the dull area and still more marked over the flat area. Vague egophony over the flat area. Posteriorly right, flatness from the angle of the scapula to the base.

Urine was normal. Wassermann examination of the blood, negative. White blood-cells showed 19,400 leucocytes, with 84 per cent. of polymorphonuclears. No tubercle bacilli in the sputum.

A difference in the two pulses showed in the blood-pressure, which was: Systolic, 100; diastolic, 40 on the right side, the left being ten points higher.

Bronchoscopy by Dr. Yankauer, on December 15. A dilated secondary bronchus was found on the right side from the middle lobe, but a lower branch also discharged pus and showed a grayish exudate.

Radiographically there was a dense shadow the size of an adult palm, roughly longitudinal, in the line of the interlobar fissure (Fig. 5).

Diagnosis before operation, bronchiectatic abscess, probably secondary to interlobar empyema.

Operation on December 28, 1914. Intratracheal ether anaesthesia by Dr. Branower. The patient had been instructed to empty his cavity before the operation. Incision was made in the sixth interspace for about nine inches, pulling the scapula out of the way by raising the arm. The entire chest was filled with adhesions so that, although anatomically within the pleural cavity, a free space existed nowhere. The fissure was easily found, and following this anteriorly the bronchiectasis was discovered densely

adherent to the chest wall and involving the posterior part of the middle lobe, while there was a considerable cavity in the contiguous upper lobe and in the lower lobe as well. It was possible to separate the posterior part of the middle lobe, and after crushing with a clamp through healthy tissue firm ligatures of chromicized catgut were put in and the portion of lobe cut away. The indurated tissues in the upper and lower lobe were surrounded by transfixion ligatures of catgut and firmly tied so as to produce strangulation, with subsequent sloughing off. A piece of the seventh rib was now resected for drainage and the entire cavity, which was fully as large as a duck's egg, was packed with gauze. This would make the total amount of lung resected very much larger than the cavity, for I did not cut away the portions of the upper and lower lobes which were diseased, but, as just stated, expected them to necrose and be cast off. At the close of the operation there was some discharge of pus and bloody fluid from the mouth. The patient stood the operation well but his convalescence was stormy. The amount of sputum was immediately checked, so that there was between one and two ounces in twenty-four hours. Naturally, infection of the wound. A note on January 22, about a month after the operation, states that the patient was up and about. The respiration still somewhat rapid. Cough slight. Expectoration almost absent. Wound still discharging.

Although the patient was able to be up, his rapid respiration and slightly elevated temperature called for another radiographic examination, and this showed to the right of the sternum and next to the heart a considerable cavity, containing fluid and air (see Fig. 6). On February 1, aspiration was performed through the fifth interspace, well to the right of the sternum, with local anæsthesia, with the idea of emptying the cavity of fluid. The needle, however, entered the original surgical wound and, causing some hemorrhage, irritated the bronchial opening within the wound, so that there was hæmoptysis and distress, lasting for several minutes. There was a bronchial opening deep within the wound and the irritating wound discharges caused an annoying cough. This was kept in check by applications of novocaine to the bronchus through the wound. The collection of pus shown in the radiograph was finally evacuated a few days later through the upper part of the wound, reached by counter-thoracotomy above the original wound. By March 15 the patient had gained weight and his color was good, but on March 19 there was a slight coughing spell, with expectoration of pink mucopus. On May 4, 1915, he was discharged in good condition, the wound soundly healed. Very slight cough. Very little expectora-

tion. At the present writing he is apparently perfectly well and is working at his occupation of shipping clerk.<sup>9</sup>

Pathological report by Dr. Mendlebaum was, "Consolidation from chronic and acute inflammation. Small abscesses."

CASE IV.—*Chronic Indurative Pneumonia with Beginning Bronchiectasis and Miliary Abscesses in Right Lower Lobe. Extirpation. Cure.*

Lawrence F., eight years old, was admitted to the Children's Service of Dr. Koplik, at Mt. Sinai Hospital, on February 27, 1915. Seven months before he had had pneumonia and a little later an exacerbation which lasted two weeks. Since then cough had persisted. Four days before admission the patient had fever, the cough became worse and there was occasional vomiting. The child had gained weight during the past seven months and on admission was in good nutritional condition. Respirations were from 32 to 64. The pulse from 100 to 144. The temperature 100 degrees to 104.8 degrees. The weight 70 pounds.

Without going into details, the case suggested one of empyema, and aspiration was said to have yielded half a drachm of pus.

A radiograph of the patient's chest showed a condition almost exactly the same as that shown in Case I. The diagnosis was made of chronic infiltrated condition of the right lower lobe on examination of the plates by Dr. Jaches, Dr. Wessler and myself (Fig. 10).

The Von Pirquet examination was negative.

Blood count, 24,000 white cells; 95 per cent. polymorphonuclears; 5 per cent. lymphocytes.

On March 3 another aspiration was performed, but nothing obtained.

The urine showed some albumin with an occasional hyalin cast and a few white blood-cells.

The boy had a pasty and septic appearance in spite of his good nutrition. Expectoration and cough were slight.

On the history and appearance of the X-ray a diagnosis of bronchiectasis of the right lower lobe was made, although it was recognized that the actual bronchiectatic condition might not be fully developed, thus accounting for the slight degree of cough and expectoration. The patient was then transferred to the writer's Surgical Service and operated upon on March 4, 1915, in intratracheal anæsthesia with ether administered by Dr. Branower. The usual long seventh interspace incision was made and it was at

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<sup>9</sup> April 29, 1916: The boy felt so well that against advice he played base-ball, and developed an abscess in the scar communicating with the chest. This is now almost healed, but the patient is in the hospital.

once seen that the two upper lobes of the lung were absolutely normal and without adhesions, except as stated below. The lower lobe was almost liver-colored, quite solid, and slightly adherent posteriorly to the upper lobe. Some of the adhesions were separated bluntly and others required ligation and division. Transfixion ligatures of chromicized catgut were now placed in succession through the tough adherent and infiltrated structures at the hilum, eventually forming a pedicle about the size of a silver quarter. After each ligature had been put in and thoroughly secured, distal section was made with scissors, until the last one was tied, when the entire lower lobe was cut away and removed. The lower branch of the right bronchus and one tributary were isolated, crushed and ligated separately, the stumps being carbolized. The general stump was also carbolized and the ligatures were left long. All were held together with another ligature and carried to the outside of the chest and fastened there. About a drachm of thick pus escaped when the lung was cut away. A small packing placed over the stump led out of the posterior angle of the wound, where room was made for drainage by removing a small section of the eighth rib. A tube was inserted alongside of the ligature and packing, because much secretion was expected. The remainder of the wound was closed with three pericostal sutures of chromicized catgut, a few muscular sutures and silk for the skin. Operation well borne. Very little hemorrhage. Pulse on leaving table was 140. Color, pink and good. Neither pus nor blood had appeared at the mouth during the operation. Soon afterward, however, there were symptoms of profound opium poisoning, with about ten respirations per minute. Dr. Branower made intrapharyngeal insufflation with air and oxygen and the patient received a three-hundredth of a grain of atropine hypodermatically. He at once revived and the respirations rose to 36. It was found that, through an error, a fifth of a grain of morphine had been given instead of a tenth of a grain, as ordered.

The day after the operation the respirations were 60. Pulse 148, but this patient at no time appeared to be dangerously ill. Morphine in tenth-of-a-grain doses was used regularly to hold down the respirations.

On section the pulmonary lobe was found studded with grayish nodules, large and miliary. The gross appearance of the specimen appeared like one of bronchiectasis. The final pathological diagnosis by Dr. Mandlebaum was "Consolidation of lung with purulent infiltration, miliary abscesses, slight dilatation of the larger bronchi, which contained purulent exudate."

During convalescence this boy developed a bronchial fistula at

the site of the stump. It closed, however, spontaneously. He was discharged well on May 18, 1915. Weight, sixty-three and one-half pounds. He has remained well to the present writing (see Figs. 11 and 12). Note also Figs. 10a and 10b, the radiograph before operation and after recovery. The horizontal line which looks almost like a fluid level is the diaphragm on full inspiration.

After discharge an irritating cough began, and this yielded only to tonsillectomy, which was done by Dr. Yankauer, in anæsthesia, with every precaution to prevent aspiration. Patient now well.

CASE V.—*Bronchiectasis Following Tonsillectomy. Resection of Middle Lobe of Lung. Cure.*

Mrs. Elizabeth M. B., about forty years of age, patient of Dr. Charles H. Richardson, had been operated upon (tonsillectomy in general anæsthesia) twenty-two months before I saw her. For years she had been a sufferer from tonsillitis with recurring quinsy. About ten days after the tonsillectomy there began the train of symptoms for which she sought relief. There was cough, with increasingly copious and putrid expectoration, characteristic attacks of fever, clubbing of the finger-tips, but with preservation of the body fat. The patient stated that she had occasionally brought up as much as a quart of stinking secretion in twenty-four hours. Possibly this was exaggerated, but from observations in the hospital it was believed that the total amount exceeded 500 c.c. There were the usual signs of cavity formation in the right lower chest. Left lung apparently normal. Repeated examinations had failed to show tubercle bacilli, except on one occasion, when eleven bacilli were said to have been found. This observation was probably erroneous.

On October 15, 1915, she entered the private ward at Mt. Sinai Hospital, where other examinations for tubercle bacilli were made but none were found. Bronchoscopy was omitted in this case because of the nervousness of the patient, which would probably have necessitated a general anæsthesia.

Dr. Wessler, of the Röntgenological Department of Mt. Sinai Hospital, reported that in the right lung, corresponding in position to the middle lobe, there was a dense, irregular, triangular shadow, with its apex situated at the right hilum and extending upward toward the axilla. The shadow extended vertically a distance of about two intercostal spaces and was well marked from the normal lung. On the oblique view of this shadow there was seen at its centre an irregular, lighter area, which was probably a cavity. The right diaphragm was abnormally high and did not move well on respiration. The upper mediastinum was somewhat pulled over into the right chest. Pleuro-phrenic adhesions on the right side (see Fig: 13).



The program was for intercostal exploratory thoracotomy with further procedures to be decided at time of operation.

On October 18, 1915, operation, Dr. Martin W. Ware assisting. In nitrous oxide and oxygen anæsthesia, preceded by a little ether (Dr. Branower), a long incision was made in the seventh interspace. Adhesions between diaphragm and lower lobe were dense and were divided between ligatures. Other adhesions peeled away. Landmarks of the interlobar fissure were at first obliterated but were later made out. The lower lobe, in spite of adhesions, was for the most part healthy. The bronchiectasis, with its grayish-red color and its rigid walls, was easily demonstrated to those present at the operation. In order to gain room the seventh rib was divided close to the angle and the rib spreader now put in. It was then possible to separate the lower lobe from the posterior part of the middle lobe until the entire diseased portion of the middle lobe was mobilized. Dense adhesions between the middle and upper lobes were separated and an abscess cavity was entered, with the unavoidable spilling of putrid pus. It was now seen that the upper lobe was adherent to the chest wall almost everywhere, although it was diseased only by contiguity. The bronchiectasis was extirpated by crushing the healthy lung with powerful clamps and then making chain ligatures of chromicized catgut and finally cutting away the diseased mass. An extra suture of chromicized gut was put in the stump and this was sutured to the chest wall to immobilize the mediastinum and prevent the danger of flapping, a danger which, however, in this case, would naturally be controlled by the adhesions of the upper lobe. The lower part of the mediastinum was soft and looked normal and the pulsations of the heart were clearly visible. Because of the presence of infection the costo-phrenic sinus was lightly packed with gauze. A packing of iodoformized gauze was laid against the lower surface of the upper lobe, where the bronchiectasis had been in contact. Other light packings were led out of the anterior part of the wound. The remainder of the incision was closed by through-and-through sutures of heavy silk and the skin with fine silk. No pericostal sutures. The operation lasted just short of one hour. Loss of blood trivial. Anæsthesia excellent. Patient's postoperative condition good. Pulse after operation 140. This patient had had a rapid pulse for nearly two years, running as high as 160. The patient made an almost ideal convalescence. The expectoration all but ceased immediately after the operation, the little that was being brought up being mostly saliva and clear mucus without a trace of odor. Patient was kept quiet and the respiration slow by regular doses of heroin. On November 1 most of the packings were removed

## THERAPEUTICS OF SUPPURATIVE BRONCHIECTASIS

and the following day the remainder were withdrawn. There was free and foul discharge from the wound and a small bronchial fistula developed. Continuous suction apparatus kept the patient comfortable, so that only one dressing a day was required. When the wound had become a mere sinus leading to the bronchial opening, a few drops of tincture of iodine were injected, but immediately caused an attack of coughing. The wound was healed on December 10, but two days later it reopened. A 5 per cent. mixture of iodoform and vaseline was then injected and the wound once more closed. Bronchial fistula entirely obliterated. Neither coughing nor blowing caused leakage. She was discharged from the hospital on December 20, 1915. On January 6, 1916, she raised a little blood-stained mucus and on January 4 had hæmoptysis of about two ounces. With rest in bed for a few weeks she recovered completely, and is well at the present writing (see Figs. 14 and 15).

This patient was timid about using her right arm and still has difficulty in raising it above her head (Fig. 15).

The specimen examined by Dr. Mandlebaum, of the Pathological Department of Mt. Sinai Hospital, showed multiple bronchiectatic abscesses.

### CASE VI.—*Chronic Lung Abscess. Extirpation of Right Lower Pulmonary Lobe. Death.*

Jacob K., fifty-three years old, a patient of Dr. George Mannheimer, of New York, was admitted to Mt. Sinai Hospital on June 16, 1915.

Temperature, 98.4 degrees. Pulse, 92. Respiration, 24.

Patient had been operated upon for cholecystitis about a year before admission and had been operated upon again on account of jaundice, in February, 1915. In March he began to cough, with foul expectoration, thick, yellowish and often blood-stained, the sputum settling into three layers. Loss of twelve pounds in three months. Anorexia. Pain on coughing.

Pallor and emaciation on examination, the skin showing pityriasis versicolor. The lungs were emphysematous except on the right side, where, from the angle of the scapula to the base and extending toward the right axilla, was flatness with occasional râles. The left sixth to seventh interspace in the axilla cracked-pot note and amphoric breathing. Clubbing of the fingers.

Urine acid; faint trace of albumin.

The X-ray showed a dense shadow, apparently an infiltration in the location of the upper part of the right lower lobe, the shadow shading off to the more healthy part of the lung.

With the diagnosis of lung abscess operation was performed on June 17, 1915, in anæsthesia, first with ether, then nitrous

oxide and oxygen by the intrapharyngeal method (Dr. Branower). Long seventh interspace incision. The posterior part of the lower lobe densely infiltrated and dark in color. The infiltration extended into the neighboring middle lobe but only to a slight degree. A few adhesions to the costal wall were cut between ligatures. The entire lower lobe was freed to the hilum; two heavy silk sutures were put in place and used as mass ligatures. In the beginning of the operation there was some blood in the expectoration which came with the initial cough when the ether mask was applied. Foul, purulent discharge also from the mouth. The pedicle having been firmly ligated, the lobe of the lung was cut away, leaving a generous stump to prevent slipping. Four bronchi were ligated separately. The entire stump was carbolyzed and covered with iodoformized gauze, which led out of the posterior angle of the wound. During the operation there was little bleeding and the patient was in excellent condition. There was not the slightest sign of respiratory embarrassment when the lung was removed, although no tension was made to hold the hilum steady. Unfortunately, the patient's good condition was deceiving and steps were not taken to fix the stump of the lung to the chest wall or to steady the stump of the lung by fixing the ligatures to the chest wall. The wound was closed in layers and three drainage tubes were left within the thorax posteriorly. The patient left the table in excellent condition, pulse about 100, color pink, and good hopes were entertained for his operative recovery. When he reached the ward, however, his respiration became gasping, his pulse feeble, and he died in a few moments. The writer feels quite certain that this unfortunate result was due to mediastinal flapping because the stump of the lung had not been fixed so as to support the mediastinum.

Examination of the specimen showed the greater part of the lower lobe a mass of gangrene and abscess cavities, the edge of the lung alone remaining in any sense normal. Pathological diagnosis (Mandlebaum), "Multiple lung abscesses and purulent pneumonia."

CASE VII.—*Bronchiectasis. Extirpation of Right Lower Pulmonary Lobe. Death.*

Joseph S., twenty-five years old, was admitted to Mt. Sinai Hospital on December 22, 1915.

Temperature, 96.8°. Pulse, 80. Respiration, 20.

Six years before admission he had had pneumonia and pleurisy and was in bed for six weeks. For a year following this pneumonia he was well, then in winter he began to be troubled with profuse greenish expectoration, which was worse during the day than at night. The expectoration would diminish

in summer and increase in the cold weather. For two years before admission he had been treated as if he had tuberculosis, until he came into the hands of Dr. George Mannheimer, who diagnosed the case as a bronchiectasis. During the greater part of the time there was neither fever nor other constitutional sign of sepsis.

General condition good when I first saw him. The right chest posteriorly showed dulness from the spine of the scapula to the base, with increased voice and breathing, with sibilant and sonorous râles. No tubercle bacilli in the sputum, the total amount of which was about eight ounces in twenty-four hours, foul and purulent in character.

The urine was normal.

For several years the patient had been unable to work and had become so depressed that he was willing to undergo even the most dangerous operation in the hope of obtaining relief.

The X-ray (see Fig. 16) showed a shadow occupying the position of the right lower pulmonary lobe and the presence of adhesions between the lung and chest wall, and between the lungs and diaphragm, could be made out. On the left side in the lower lobe there were a few small shadows which it was thought also represented consolidation.

On December 27, 1915, Dr. Branower administered enough ether to narcotize the patient and then continued the anæsthesia with nitrous oxide by the intrapharyngeal method. The chest was entered by a long incision in the eighth interspace and more room was obtained by dividing the eighth rib, and, finally, by removing the greater part of this rib and dividing the seventh rib, also just in front of the angle, and again near the cartilage. The rib spreader was put in and plenty of room obtained. At the first examination the case was supposed to be inoperable on account of dense, tough, fibrous adhesions all around, uniting the lobes of the lung and gluing the entire lower lobe to the chest wall and to the diaphragm. With difficulty and with great expenditure of time the adhesions were divided between ligatures until the lobe was mobilized. It was removed by crushing the pedicle with a special clamp devised by Dr. Yankauer, the blades of which were made, at my suggestion, cylindrical and smooth, so as to avoid cutting the tissues. The pedicle having been crushed to a ribbon, it was ligated with chain ligatures of chromicized catgut and the lobe removed.

On section the lobe was found infiltrated and traversed in all directions by greatly dilated bronchi.

During the operation there was a slight show of blood in the secretion from the mouth. The division of so many adhesions,

however, in spite of all precautions, meant the loss of probably eight ounces of blood. The entire right diaphragmatic surface was raw. All bleeding had apparently ceased at the end of the operation, which took nearly one hour and a half. The ribs were approximated by pericostal sutures of chromicized catgut and a good-sized suture was put through the pedicle and fastened to the chest wall.

At the end of the operation the patient's pulse was 140, but of good quality. His appearance, however, was that of shock, and he received twenty ounces of saline solution subcutaneously. Two hours later the pulse-rate had risen to 168. Respiration, 20. Slight cough, with blood-tinged sputum. At 7.30 in the evening, three and a half hours after he had left the operating table, it was necessary to give him an intravenous infusion of saline solution. At 1.30 A.M., on the 28th, he received 300 cubic centimetres of blood transfused by the citrate method. Pulse good, about 144. During the day his condition improved and we had great hopes of his recovery, but during the night he became unconscious. The right pupil became dilated, the left contracted (meningitis?). Lumbar puncture was performed and clear fluid obtained under increased pressure. The temperature rose to  $107\frac{1}{2}$  degrees and the pulse, which had remained good, suddenly became weaker. He died about forty hours after operation.

In this case one thinks of what might have been done and of what might have been left undone. Perhaps an attempt at a two-stage operation might have been more successful. At any rate, it would have been wise to have had a donor ready for transfusion before operation, so that in case of necessity the blood could have been put in at once. This is a precaution which I intend to take in future. Also, it might have been wise to put ligatures around the thighs before the operation to reduce the blood-pressure. The operation was, as a matter of fact, too long by about thirty minutes, although we were deceived by the patient's good condition on the table.

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NOTE.—Many references to the literature of this subject may be found in publications 1, 2, and 12 of the above list.

CHRONIC NON-TUBERCULOUS PULMONARY SUPPURATION. CASES OF EXTIRPATION OR ATTEMPTED EXTIRPATION OF LESION

No.	Initials	Sex	Age	Probable etiology	Location of lesion	Date of operation	Anæsthesia	Character of operation	Result	Bronchoscopic copy	Remarks
I	F. W. ....	M	3½	Aspiration of foreign body	Right lower lobe	Feb. 27, 1914	Ether intrapharyngeal	Extirpation of entire lobe	Well	Yes	No bronchial leak after operation. Tachycardia.
II	J. S. ....	M	36	Unknown....	Right lower lobe and part of upper lobe	June 11 1914	Ether intratracheal	Attempted resection	Dead	Yes	Operation abandoned before mobilization of diseased lung. Cause of death hemorrhage.
III	D. J. ....	M	16	Unknown (pneumonia?)	Middle lobe	Dec. 28, 1914	Ether intratracheal	Resection of upper, lower and middle lobe	Well	Yes	Disease in middle lobe with extension into upper and lower lobes. Secondary local emphysema. Temporary bronchial leak.
IV	L. F. ....	M	8	Pneumonia...	Right lower lobe	March 4, 1915	Ether intratracheal	Extirpation of entire lobe	Well	No	Bronchoscopy omitted. Should have been done though no harm came from its omission. Temporary bronchial leak.
V	E. M. B. .	F	40	Aspiration during tonsillectomy	Middle lobe	Oct. 18, 1915	Ether, then gas and oxygen. Intrapharyngeal	Resection.....	Well	No	Temporary bronchial leak. Postoperative hæmoptysis. Is now well.
VI	J. K. ....	M	53	Exploratory laparotomy (aspiration)	Right lower lobe	June 17, 1915	Ether, gas and oxygen, intrapharyngeal	Extirpation of lobe	Dead	Yes	Death probably due to mediastinal flapping. Fixation of stump was omitted.
VII	J. S. ....	M	25	Pneumonia...	Right lower lobe	Dec. 27, 1915	Ether, gas and oxygen, intrapharyngeal	Extirpation of lobe	Dead	Yes	Sepsis. (Lived 48 hours.)

CASES OF CHRONIC NON-TUBERCULOUS PULMONARY SUPPURATION TREATED BY PALLIATIVE OPERATIONS  
The first six cases have already been reported (ANN. SURG., Vol. 59, 1914)

No.	Name	Sex	Age	Disease	Date of operation	Anæsthesia	Type of operation	Results			Remarks
								Cured	Improved	Died	
1	Barney F.	M	55	Bronchiectasis	Feb. 21, 1910	Intratracheal ether	Exploration	..	..	1	Died one year later of pulmonary hemorrhage.
2	Isidor B.	M	19	Bronchiectasis	(1) Aug. 17, 1911 (2) Apr. 12, 1912	Inhalation ether Insufflation ether	Thoracoplasty	..	..	..	The other lung became acutely infected.
3	Geo. R.	M	30	Bronchiectasis	Feb. 16, 1912	Intratracheal ether	Thoracoplasty	..	1	..	Seen a year later. About as bad as ever. Refused further operation.
4	Harry L.	M	41	Chronic abscess with development of putrid abscess (acute)	Mar. 29, 1912	Intratracheal ether	Thoracotomy and drainage	..	..	1	Died four days after operation. Pneumonia and sepsis. Tuberculosis. Error of irrigating the abscess at time of operation may have been to blame. Through drainage, suppurative region to infra-clavicular region.
5	Victor H.	M	12	Chronic abscess at apex	Jan. 12, 1913	Inhalation ether	Thoracotomy and drainage	1	..	..	Permanent bronchial fistula (present before operation and not cured).
6	Antonia S.	F	26	Bronchiectasis	May 26, 1913	Insufflation ether	Thoracoplasty and drainage	..	1	..	Operation (transsternal) had to be abandoned because of firm adhesions at pedicle and poor condition of patient. Died in six days of mediastinal infection.
7	Harry G.	M	24	Bronchiectasis	(1) Dec. 20, 1912 (2) Nov. 21, 1913 (3) Nov. 9, 1914	Intratracheal ether Inhalation ether Intratracheal ether	Thoracoplasty and drainage Thoracoplasty (large) Attempted ligation of branch of pulmonary artery through mediastinum	..	1	..	Was discharged "improved" but not well enough to work.
8	Louis G.	M	33	Bronchiectasis	Mar. 11, 1914	Intratracheal ether	Thoracotomy and drainage	..	1	..	
9	David L.	M	49	Bronchiectatic abscess with perforation into pleura	June 20, 1914	Nitrous oxide and oxygen inhalation	Long intercostal thoracotomy and drainage	..	1	..	
10	Minnie K.	F	29	Bronchiectasis	Aug. 23, 1915	Nitrous oxide and oxygen inhalation	Thoracotomy and drainage (rib resection)	..	..	1	Other lung became involved. Death from hamoptysis and hemorrhage from wound November 3, 1915.
11	James S.	M	53	Bronchiectatic abscess	Oct. 22, 1915	Nitrous oxide and oxygen inhalation	Large thoracotomy, drainage 5 days later with cautery	..	..	1	October 31, 1915, died in a few minutes of severe hemorrhage at a dressing. Patient greatly relieved. Permanent opening intended. Old luetic history.
12	Louis H.	M	44	Bronchiectatic abscess with perforation into pleura	(1) Nov. 3, 1915 (2) Nov. 27, 1915	Nitrous oxide and oxygen inhalation Local (novocaine)	Thoracotomy and resection 6 inches rib with peristeam Phrenicotomy	..	1	..	



# THE HANDLING OF CHILDREN WITH TUBERCULOSIS OF THE SPINE WHILE THEY ARE UNDER THE INFLUENCE OF AN ANÆSTHETIC \*

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It is possible that we have not heretofore given enough consideration to the fact that a child suffering with tuberculosis of the spine, and while conscious and in full control of its voluntary muscles, is a very different object from the one which lies unconscious and relaxed under an anæsthetic.

The spinal column is deeply imbedded in and supported by the intrinsic and extrinsic muscles, and these, being under voluntary control, can instantly change the spine from a pliable and yielding column into a firm and unyielding one. This power of voluntary control and self-protection is, of course, entirely lost under an anæsthetic. Likewise, the reflex muscle spasm is also lost. It is, however, the voluntary control, and the loss of it, which is the important feature.

Therefore, the spine of a child who is conscious and in full voluntary control of his movements might be compared to a watch-chain imbedded in paraffin. Under these circumstances the watch-chain could be lifted by both ends without its sagging, or one end can be rotated between thumb and finger, and the whole chain rotates in corresponding fashion. But if the paraffin is melted, the chain once more becomes limp and sagging, link moves in link, torsion at one end is gradually communicated from one link to the next until the limit of motion is reached, and so on throughout the length of the chain until perhaps one end has been rotated several times.

And so when handling a normal child we find the same condition. We lift the child in our arms and he naturally and instinctively makes a bridge of his backbone across our supporting arms. And the same is true of torsion of the spine—he instinctively resists it.

If this is true of a normal child, it is even more marked in one whose spine is diseased. Here all the elements of self-protection and guarding against injury are amplified, the child's nervous system is hypersensitive, and carefully but positively does he voluntarily protect his weakened and tender spine when he is lifted or turned over.

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\* Read before the Philadelphia Academy of Surgery, March 6, 1916.

## TUBERCULOSIS OF THE SPINE

Under the relaxing effect of ether anæsthesia this power of self-protection is lost and the spine sags and bends when the child is lifted, and torsion at one end of the spinal column is carried segment by segment the length of the spine, one vertebra rotating on the next one, to the limit of motion, and so on down. So we have the analogy to the watch-chain.

Now let us imagine that we have removed the spine from a child suffering with Pott's disease, and as we hold it in our hands we examine it. What do we find? Here is one with a rather sharp, angular kyphosis at the tenth dorsal vertebra. The body of the tenth dorsal has entirely disappeared, the anterior edge of the body of the ninth is resting upon the anterior edge of the body of the eleventh and in the triangular space thus formed by the bones is the soft cheesy material—the tubercular débris of the disease—and it is also under tension, for the periosseous and periarticular structures are bulging at the sides and may at any moment give way. For the retaining walls are rotted through and through, they are weak and friable, and serve only as a feeble barrier to protect the surrounding tissues. But the plastic exudate and organized lymph are doing what they can to reinforce the protecting wall. The age of this child may be perhaps three or four years.

Let us take up another specimen—the spine of a child about ten or eleven. Here a different condition prevails. There is rather an obtuse kyphosis in the lower dorsal region, involving the ninth, tenth and eleventh vertebræ. The body of the tenth has entirely disappeared, the intervertebral cartilages have been absorbed, the disease has been making inroads into the inferior portion of the body of the ninth and the superior portion of the body of the eleventh, but these two bodies are not resting the one upon the other, as in the previous case, but are separated by a considerable space. This space is filled completely with the soft mass of tubercular material, and as it is under some tension, it has forced its way into the spinal canal, entirely surrounding the spinal cord, and yet is held in restraint by a limiting wall of plastic exudate, which prevents its free escape into the spinal canal. The contrast between this spine and the previous one is very striking. Why is it that in the one case bone rests upon bone, while in the other there is the wide gap between the bodies? The history tells us that this latter child was treated for many months lying supine upon a Bradford frame, and there is every evidence that the disease continued to make progress in spite of the treatment. Now if pressure be made upon the ends of this spine it easily buckles at the apex of the kyphosis; that is, it closes as a hinge would. The increased pressure upon the abscess must cause it to

rupture at its weakest point, just as the artist, pressing in the sides of his tube of paint, expels the paint upon his palette. The abscess, therefore, may be expressed into the surrounding tissues, or into the spinal canal, or even into the spinal fluid itself, thus setting free in the cellular tissues and their lymphatics, or in the spinal fluid, large quantities of toxins.

In regard to the first spine, where bone rests upon bone, very little harm would result from pressing the ends of the spine together. But by making traction upon them the opposite effect is produced. The ligamentous structures, necrotic from the disease, easily tear and give way and the spine straightens, the kyphosis opening at its apex like a hinge, and tubercular material with its toxins may be set free in the surrounding cellular tissues and taken up by the lymphatics.

There is another factor to be considered. The intimate relationship of the great, the lesser and the smallest splanchnic nerves to the thoracic vertebræ is important. When we consider the situation of the sympathetic ganglia from which these nerves arise—the intercommunication between these ganglia and the spinal nerves and the spinal cord—the fact that these sympathetic nerves lie in such close contact with the bodies of certain of the vertebræ and terminate in the solar plexus and renal plexus, and further, that the ganglia themselves are directly connected with the bodies of the vertebræ by nerve filaments which pass into the bone, then we can see what effect traumatism in this region must have upon the general condition of the patient. Stretching and tearing of these delicate nerve structures so close to the spinal axis may produce sudden and severe shock. Likewise compression or pinching of the nerve tissue may produce shock.

What is the clinical application of these facts?

CASE I.—A child of three, with a moderate angular kyphosis in the lower dorsal spine, is considered a suitable case for a bone-grafting operation. His condition remains good throughout, with very little disturbance of his pulse or breathing. When it is time to apply the plaster bandages the patient is lifted from the table by the shoulders and pelvis. His trunk sags forward into hyperextension and a perceptible change takes place in the contour of the kyphosis. It has diminished. The plaster was put on rapidly and carefully, and perhaps not more than five minutes passed until it was completed; and yet, during this interval, the child changed from a condition of safety to one of shock. The change itself came very quickly and without warning, and he gave his doctors considerable concern until reaction was finally established.

In this young patient with tender and delicate structures, weak and friable from disease, we believe there was an actual though slight giving way of the spine at the apex of the kyphosis; or in other words, it opened a little as a hinge would open. The child's temperature, which had been running close to the normal previous to the operation, reached  $104^{\circ}$  on the second day and then gradually declined, and his condition became entirely satisfactory.

CASE II.—A child of ten or eleven had had tuberculosis of the spine for several years and had not done well. Her resistance was poor. She was put to bed on a Bradford frame, with extension on her head and lower limbs. Both lower limbs were paralyzed. After a year and three months of this treatment she was still paralyzed.

Dr. Spiller then saw her in consultation with me. From every point of view the case was not promising. But we concluded that if the spine could be made rigid by bone grafting, it would give her the best chance for improvement, and we hoped that eventually the pressure on the cord might be relieved and she might regain the use of her lower limbs. We at least had hopes of seeing her up in a wheel-chair. It seemed to me that she could be carried safely through the operation. The mother was very anxious to have anything done which promised even a little improvement.

A plaster jacket was made on the day preceding the operation and cut down both sides, so that it could be quickly and easily applied the moment the operation was completed.

At the time of the operation the child was handled with the utmost care. She was lying prone upon the table, completely relaxed under the anæsthetic, and we were about to proceed with the second step of the operation—that of inserting the bone-grafts into the spinous processes—when an unforeseen thing happened. Our anæsthetizer, thinking the child was lying a little too near the head of the table, pushed her by the shoulders. Instantly the spine buckled. That is at the apex of the kyphosis it folded together like a hinge. Very carefully we straightened her out again into her former position and proceeded with the operation. In cutting longitudinally from the base of one spinous process to the base of the next one, just about at the apex of the kyphosis, some tubercular material was seen. The child was severely shocked by the time the operation was completed. She was put into the plaster jacket and back to bed. She gradually reacted and we began to feel hopeful for her recovery. The next day her temperature was  $105^{\circ}$  and our hopefulness changed to doubt. The day following her temperature reached  $105\frac{3}{5}^{\circ}$ , and we were completely discouraged. There was no sign of pneumonia, no evidence of meningitis. The patient died on the third day.

I must assume the responsibility for the child's death. I do not know definitely the cause of her death. It is not my purpose either to criticise or to censure. It is possible, however, that we have grown too accustomed to think of a kyphosis as a compact mass of bone.

If there is an undercurrent of truth in the points which I have endeavored to bring out, how can we guard against these accidents?

The solution seems simple enough.

On the day preceding the operation the child should be placed prone upon a muslin hammock stretched fairly taut, but sagging a little with the child's weight. The body is swathed with a layer of cotton and, if desired, the pelvis protected with a girdle of felt and likewise a strip of felt on each side of the ridge of the spine, to prevent pressure on the tips of the spinous processes. The plaster jacket is then applied and cut down each side in the midaxillary line.

At the time of the operation the child is placed supine upon the table, the front of the plaster jacket is then removed, and the anæsthetic started. (A child should never be given an anæsthetic while his thorax is completely enclosed in a plaster jacket.) A few minutes later the front of the jacket is replaced and held firmly in place by two assistants, while the child is turned over into the prone position. The back of the plaster jacket is removed, the operation performed upon the spine, a light gauze dressing put on, and the back of the jacket with its cotton replaced, fastened firmly with girdles of adhesive plaster, and the child returned to its bed.

In this way all twisting and unnecessary movements of the spine are avoided.

We have often watched two assistants—perhaps the etherizer and a nurse—turning a child over on the operating table. Almost never do they act in perfect accord. The shoulders are turned a little before the pelvis or the pelvis a little quicker than the shoulders, and consequently there is the inevitable twist or torsion of the spine. The simple measures which I have outlined will effectually guard against this.

And so I have come to believe that, first, the operation of bone-grafting upon the spine of a child is of itself accompanied by comparatively little shock.

Second, these children bear the anæsthetic surprisingly well, provided of course, it is properly given; and

Third, the handling of these children with diseased spines while they are relaxed under the anæsthetic is the most vital point in the whole procedure.

# THE ELEMENT OF ERROR IN ABDOMINAL DIAGNOSIS \*

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A FEW months ago I heard a distinguished surgeon say that, had he life to live over, being fully conscious that brilliant operators are infinitely more common than great diagnosticians, he would desire to become a clinician. No more fascinating field exists in medicine than surgical diagnosis; and yet, what branch has so few masters? No less interesting are the commoner errors of surgical diagnosis, and particularly engrossing is the study of the seemingly inevitable mistakes made in the diagnostics of abdominal disease.

Absorbed with this subject, I, some time ago, at Rochester, kept record of the errors made in a series of general cases admitted to the diagnostic department of the Mayo Clinic. Eleven hundred and seventy patients were studied, about one-half of these coming to operation. With the latter group it was found at the operating table that there was a gross error in the primary diagnosis of the clinicians in 10.08 per cent. In all of these the surgical indications were correct and the patient required an operation for relief, but in the percentage stated the clinical diagnosis was wrong.

The original diagnosis, with the operative findings, in all cases in which gross errors were made were studied, but at this time only those with abdominal diseases are considered and are presented in the following table:

## GROSS ERRORS IN DIAGNOSIS CHECKED AT OPERATING ROOM

Clinical Diagnosis.	Operative Diagnosis.
1. Perforating gastric ulcer .....	Chronic cholecystitis and appendicitis
2. Aortic aneurism.....	Ovarian cyst
3. Chronic cholecystitis.....	Duodenal ulcer
4. Duodenal ulcer.....	Chronic appendicitis
5. Duodenal ulcer.....	Chronic cholecystitis
6. Duodenal ulcer.....	Chronic appendicitis
7. Chronic appendicitis.....	Duodenal ulcer
8. Carcinoma of the stomach.....	Septic gall-bladder with stones

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Clinical Diagnosis	Operative Diagnosis
9. Duodenal ulcer.....	Chronic cholecystitis
10. Duodenal ulcer.....	Chronic appendicitis
11. Chronic appendicitis.....	Gall-stones
12. Pyloric ulcer.....	Carcinoma
13. Ovarian cyst.....	Hydronephrosis
14. Extension of pus pocket from peri- neal abscess.....	Pancreatic cyst
15. Chronic cholecystitis.....	Carcinoma of the stomach
16. Chronic appendicitis.....	Hydrosalpinx
17. Ovarian cyst.....	Fibroids
18. Hemorrhagic endometritis.....	Fibroids
19. Neurosis (explore) appendix?.....	Chronic cholecystitis with stones
20. Reflex (explore).....	Gall-stones
21. Chronic appendicitis.....	Chronic cholecystitis
22. Functional stomach (explore).....	Strawberry gall-bladder (chronic chole- cystitis)
23. Duodenal ulcer.....	Carcinoma of stomach
24. Carcinoma of stomach.....	Old duodenal ulcer
25. Ovarian cyst.....	Hydrosalpinx
26. Pyloric obstruction (ulcer).....	Chronic cholecystitis
27. Carcinoma of cæcum .....	Chronic appendicitis with abscess
28. Gastric ulcer .....	Thickened pyloric ring (congenital)
29. Fibroids .....	Ovarian cyst
30. Pyloric obstruction-ulcer.....	Syphilis of stomach
31. Intestinal obstruction; postoperative adhesions.....	Ring carcinoma of transverse colon

It is interesting to note that of these errors over 75 per cent. have to do with the duodenum, gall-bladder or appendix. The majority of patients with disease of one or more of these organs have an accurate diagnosis made of the condition, but, in a certain percentage, as has been shown, gall-bladder disease is mistaken for duodenal ulcer, duodenal ulcer for chronic appendicitis, chronic appendicitis for gall-stones, and so on. The close relationship existing between the gall-bladder, appendix and duodenum has long been known and Rosenow,<sup>1</sup> in his recent work on the elective localization of the streptococci, has added the latest data to prove the fact. Our knowledge of this and the clearer realization of the difficulties of differential diagnosis of conditions affecting these organs have rendered the spectacular McBurney's incision, with its limited exploratory field, considerably out of fashion. The list of errors presented would have been much smaller had not a straight, rectus incision been made in most of the cases. The incompleteness of an operation performed through a gridiron incision on a chronic appendix, not presenting an absolutely clear picture,

particularly in an adult, cannot be questioned. Such an operation leaves the surgeon in but a slightly better position than the gastro-enterologist who cures gastric and duodenal ulcer, and is only kept from knowing he hasn't by the thickness of the abdominal wall. The surgeon routinely following this practice has no check on his diagnosis and will have a satisfying small percentage of errors to record.

The extraordinary similarity in symptomatology often existing between chronic appendicitis and duodenal ulcer is a subject sufficiently threadbare to be omitted were it not for the fact that the point is being constantly overlooked and is a potent factor in rendering abdominal diagnosis anything but an exact science. Not uncommonly does a patient present a history of hunger pain relieved by eating or the taking of alkalies and occurring with definite periodicity with nothing to account for the syndrome but a chronic catarrhal appendicitis. And to strengthen the diagnosis of duodenal ulcer the gastro-enterologist may report a marked hyperacidity, and the röntgenologist hyperperistalsis, or other suggestive signs; and when the operation is performed the duodenum is found normal and the removal of a chronically inflamed appendix cures the patient. I have records of several such patients in whom a 90 per cent. diagnosis of duodenal ulcer was made on a clear, uninvolved, so-called text-book history, who were completely relieved by the removal of their appendices. One patient gained eighteen pounds in the first sixty days following his operation.

Of the 264 cases of gastric ulcer operatively demonstrated at the Mayo Clinic during the year 1913-14, and studied by Eusterman,<sup>2</sup> there was an error in the primary diagnosis in 33 per cent. though an alternative diagnosis of gastric ulcer was made in 8 per cent. In 27 per cent. of the cases of gastric ulcer the primary diagnosis was duodenal ulcer.

Of 814 cases of duodenal ulcer observed in the same period there was an error in the primary diagnosis also in 33 per cent. In 10 per cent. of the cases of duodenal ulcer the diagnosis was gastric ulcer.

"Ninety per cent. of supposed diseases of the stomach are not entities but rather groups of symptoms masquerading as diseases and named accordingly" (Mayo). To no small extent is the converse true—that a certain percentage of actual surgical conditions affecting the stomach, duodenum, appendix or gall-bladder parade a horde of incoherent, intangible, irrelevant symptoms masquerading as nothing in particular, unless it be neurosis—the diagnosis too frequently made. Thus we are sorely in need of more accurate methods of procedure in surgical diagnosis, particularly as applied to the upper abdomen. The clinical history stands first in importance, but it is frequently unreliable.



The Cammidge and other tests have become but unpleasant memories, though they had some value. Even with the assistance rendered by the test meal, gastric diagnosis is anything but positive and methods of greater precision are looked for. For several years there has loomed large on the horizon the X-ray, and now to such an extent has it come to the front that it can be said with truth that nothing in the past decade has so advanced abdominal diagnosis as has röntgenology. Fluoroscopic examination, supplemented by plate studies and, in suspected ulcer, fluoroscopic examination combined with serial plate investigations, have increased the degree of diagnostic accuracy by means of the X-ray to nearly 80 per cent. for duodenal ulcer, 90 per cent. for gastric ulcer and over 95 per cent. for gastric cancer.

The commonest errors in abdominal diagnosis are made in connection with lesions of the gall-bladder, duodenum and appendix, but in this regard, and only second in importance, are the mistakes made in rendering a pre-operative diagnosis in diseases of the urinary system. Renal and ureteral stones, often presenting symptoms simulating anything but those of the classical picture of calculi, are factors accounting for many of our diagnostic errors. Not only is the history in these cases often confusing in the extreme but the invaluable signs, fortunately present in the majority of cases, are often absent. Thus Cabot<sup>3</sup> shows that in a series of 150 cases of renal and ureteral calculi the urine was entirely and persistently normal in 14 per cent. and macroscopic and microscopic blood was absent in 32 per cent. Even the X-ray is useless in a certain percentage of cases of urinary calculi, failing in 10 to 15 per cent. in Cabot's<sup>3</sup> series and in 11 per cent. in that of Braasch.<sup>4</sup>

The patient with a small ureteral stone, presenting an uncertain history, with repeatedly negative urine and nothing to show on the X-ray plate, particularly if there is a large element of neurosis in the make-up, will be frequently dismissed, branded neurasthenic, or, if he has fallen into the hands of an accommodating surgeon, will be stamped neurasthenic and simultaneously his appendix will be transferred to the formalin bottle. It is in these vague cases that the cystoscope and the pyelogram are of greatest value, and failure to resort to them often results in diagnostic humiliation. Not only in the vague but occasionally in obvious cases are gross errors made. Thus, the large clinic does not exist in which, at some time or other, one of its surgeons has not cut down upon a perfectly apparent cystic gall-bladder or splenic tumor only to regret he had not a posterior incision through which to remove the hydronephrotic kidney he has brought to light.

To every clinic come a large number of patients presenting so few

definite symptoms and such a vast amount of vague, indefinite, irrelevant data as to render the making of an exact diagnosis utterly impossible. To certain of these the title of neurasthenic is applied, a term often contracted by the exasperated and irreverent examiner to "neuro."

To the conscientious diagnostician these patients are especially trying, for, though the examiner may feel from the first few minutes of the conversation that the diagnosis is obvious, he lives in constant fear that in the incoherent recital somewhere lurks a point of great significance and that the definitely neurasthenic patient's symptoms may, in a large measure, be the result of some organic, curable condition which he may completely overlook. The attempt to bring clarity out of the tale of symptoms as presented by the full-fledged neurasthenic is the most difficult thing in medicine, and there is no task in the law or ministry approaching it.

To send a patient away branded neurasthenic is often to acknowledge defeat, but to dismiss the patient with that diagnosis only to meet her on the street a month later, obviously in excellent health, is to excite wonder and amazement equalled only by the shock of hearing of her operation for duodenal ulcer, gall-stones, renal calculus or what not at the hands of a more astute brother.

The deadly boredom associated with the daily, routine examination of a large number of patients, presenting a horde of symptoms, and yet having no definite organic lesion, accounts for a certain percentage of errors in diagnosis. The effect of the neurasthenic on the examiner is, not only to make him less alert in the study of patients of this type, but to render him often casual and superficial in investigating the condition of persons who, though they have organic disease, possess also a large element of neurosis. This type of patient is likely to direct the thoughts of the diagnostician far afield by immediately entering upon an exhaustive recital of irrelevant matter.

In a group of over one thousand consecutive patients admitted to the general diagnostic department at Rochester, 17 per cent. were sent away with the lone diagnosis of neurosis—17 per cent. of defeats—and these only acknowledged after every means had been exhausted to render a more scientific decision! In this group, however, is recorded one patient as having returned for re-examination and, though the final diagnosis was 100 per cent. for neurosis and a bare 10 per cent. for chronic appendicitis, she was so clamorous for an operation that an exploration was performed on the strength of the lone 10 per cent. and was promptly relieved by the removal of her gall-bladder and the thirty

or forty stones contained therein. Such a case is an exception, however; and, although this patient had organic disease, the symptoms were unquestionably vague, and the picture was completely masked by the neurotic manifestations which, in all probability, will remain to a great extent, even now that the organic condition has been corrected. The cure of definite surgical disease in a chronic neurasthenic does not, unfortunately, always mean the cure of the neurosis.

Two other groups of cases are customarily, as with the unfortunate and ever-present neurasthenics, examined with less exact care than they deserve, and the frequent superficial study of these individual results in very materially adding to the percentage of error in general diagnosis. The patient whose condition is complicated by alcoholism or venereal disease is apt to be considered with less seriousness by some and with more or less contemptuous disdain by others, the accuracy of the final diagnosis being regulated by æsthetic rather than scientific factors. The Wassermann has gone far in revealing to us the magnitude of the rôle played by syphilis in human disease, and the liability of the diagnostician to overlook latent lues is still another factor adding to the element of diagnostic error. The most important conclusion to be drawn from recent investigations in specific disease is that it is even more prevalent than is ordinarily supposed. The demonstration that of 4000 general hospital patients routinely subjected to the Wassermann test 600 gave a complete fixation justifies such a belief.<sup>5</sup> Since in tabes, the one syphilitic condition with which ye are chiefly concerned in a study of errors in abdominal diagnosis, but 18 per cent. give positive Wassermann's in the blood, the necessity, in obscure abdominal cases, even with negative pupil and patella reflexes, of an examination of spinal fluid is apparent.<sup>5</sup> Cases of unsuspected syphilis greatly outnumber those frankly syphilitic among patients applying for treatment at a general clinic.

In the past few years several writers, among them Cabot<sup>6</sup> and Hall<sup>7</sup> in this country, and König,<sup>8</sup> Lomnitz<sup>9</sup> and others in Europe, have directed attention to operations for supposedly local abdominal disease in patients suffering with tabes dorsalis in whom no lesion was found at laparotomy. With the Wassermann reactions on the blood and spinal fluid becoming matters of routine we have learned that any imaginable combination of abdominal symptoms may be due to cerebrospinal syphilis. It is nearly fifty years since Charcot<sup>10</sup> wrote, "of all the visceral symptoms which may display themselves from the period of lightning pains, one which is the most remarkable and least known, if I mistake not, is that which I have proposed to designate by the name

of gastric crisis. . . . Very often its real significance remaining misunderstood, it is the occasion of grave errors in diagnosis."

Of one thousand tabetics recently studied by Nuzum,<sup>11</sup> 8.7 per cent. had been subject to laparotomy one or more times under a mistaken diagnosis. Gastric ulcer was the diagnosis most frequently made, and next gall-bladder disease, with the appendix a close third. In other tabetics on whom useless operations were performed the diagnosis ranged from renal calculi to ectopic gestation. Such mistakes are not made through clinical ignorance, but as the result of superficial examinations, with hurried history taking, in which significant data are overlooked. A history of vomiting, paræsthesia, rheumatism, bladder disturbances, etc., in doubtful cases, even with normal pupils, demands a cytological examination of the spinal fluid, together with a Wassermann.

In reducing the element of error in diagnosis to a minimum in a large series of cases, as is yearly examined in every great clinic, a system of efficiency in the department of clinical diagnosis must be developed to as high a degree of perfection as possible.

At the Mayo clinic the new patient is ordinarily placed in charge of one man, and as many days or weeks as he may deem necessary are devoted to the study of the case. Unlimited time and effort are given to the task. Experts in laboratory procedures, in cystoscopic examination, in röntgenology, are immediately at hand, to whom the patient is sent for special study. All data are then collected and correlated by the original examiner and the diagnosis made.

In the daily routine of clinical work, many and varied physical abnormalities in the patient, as well as significant and important evidence in the history, will be completely overlooked, even by the most painstaking examiner. This alone helps to increase the element of error not an inconsiderable degree, and, in developing our system of diagnostic efficiency, must be considered. To eliminate this more than one clinician should, after all data have been collected, re-weigh the evidence, and at Rochester this is the invariable rule. Thus, in 3 per cent. of the patients studied, was the consultant able to elicit highly important facts from the history which had been completely overlooked by the first examiner. In over 3 per cent. valuable details in the physical examination were noted by the consultant and were added to the evidence and, finally, 4.1 per cent. of the final diagnoses, as made by the original examiner, were checked up and corrected by the consultant.

The patient with vague intra-abdominal symptoms, presenting himself for the first time, will require in the neighborhood of an hour for his first examination. Thus in the clinic where the studies forming the

basis of this paper were made the examiner, working eight hours a day, will average between seven and nine cases. Let this number be increased to twelve or fourteen, and the diagnostic mistakes that would immediately appear as the result of the necessitated haste would at once be so apparent and humiliating as to cause an immediate reduction in the number of new cases daily investigated. Even with infinite care in the study, during an eight-hour day, of but seven or eight cases, significant data in the history and valuable details in the physical examination will be overlooked. An investigation of the latter question revealed that in making general physical examinations the commonest details missed ran as follows:

Small ovarian cysts and other pelvic masses.

Small adenomata of the thyroid.

Small hyperplastic thyroids in early hyperthyroidism.

Enlarged cervical, axillary and other lymphatic glands.

Pre-systolic and other valvular murmurs.

Absent knee-jerks.

Thickened seminal vesicles.

Splenic enlargements.

Epigastric masses in carcinoma of the stomach.

High rectal metastases in carcinoma of the stomach.

Eye signs (in high tabes and other cord and cerebral lesions).

Sclerotic pallor suggesting the anæmias.

Rectal and recto-sigmoid masses in carcinoma of the rectum.

Finally, and probably the most dangerous, omissions result from the failure to recognize the direct indication for some special form of study in the case. Thus a serum test, a fluoroscopic examination, a pyelogram or an examination with the proctoscope, may be all that is needed to at once brilliantly illuminate a hitherto obscure problem.

In moments of pessimism when, after the clinician has delved exhaustively in a case for days only to see the diagnosis of which he was sure proven at the operating table to be grossly wrong, is he apt to muse, that, withal, the best diagnostician is but the cleverest guesser.

Even with the immeasurable assistance rendered us by the culture tube, the Röntgen ray, the blood count and the serum reactions, the prime requisites to the making of a successful diagnostician are the same to-day as they were when the Crookes tube, the microscope and the guinea-pig were unknown to medicine. And so is the ancient statement truer than ever, that incorrect diagnoses are oftener made as the result of lack of care in the making of the examination than as a result of lack of knowledge of how that examination should be made.

## ERROR IN ABDOMINAL DIAGNOSIS

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# SURGERY OF THE GALL-BLADDER \*

WITH ESPECIAL REFERENCE TO CHANGES IN TECHNIC

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NUMEROUS incisions have been devised through which to reach the gall-bladder. The incisions most frequently used in this country are Mayo-Robson's and Bevan's.<sup>1</sup> The longitudinal part of Bevan's incision is in the linea semilunaris. This is objectionable because the intercostal nerves to the rectus muscle cross the linea semilunaris and are likely to be cut, and also because at the linea semilunaris there is aponeurosis only and no muscle, and the strongest closures are made where there is both aponeurosis and muscle.

In the Mayo-Robson incision the rectus muscle is split longitudinally, which injures it and interferes with the nerve supply to the inner portion.

A few years ago one of us (Collins<sup>2</sup>) devised a diagonal incision for reaching the gall-bladder, which had three advantages. First, it was a non-continuous incision in that it did not give a direct opening through all the layers of the abdominal wall into the abdomen, which permitted, in closing, the strong features of a gridiron incision. Second, it did not injure the nerve and blood supply of the rectus muscle. Third, it was placed over a portion of the abdominal wall that contained both aponeurosis and muscle.

It had one disadvantage in common with Bevan's incision. It could not be extended upward or downward. If the gall-bladder was found lying above or below its usual location, or, if it was found desirable to remove the appendix, this was, at times, a disadvantage. The recent tendency in surgery has been toward general exploration of the abdomen while the incision is open, which demands larger incisions capable of extension, if necessary.

In order to remove this disadvantage, and at the same time retain the advantages, the diagonal part of the incision is now made longitudinally. This makes a non-continuous longitudinal incision, or what might also be called a "tongue-and-groove" incision. The skin, fat,

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and anterior wall of the sheath are incised longitudinally about an equal distance from the edges of the rectus muscle (Fig. 1). The inner half of the muscle is separated from its sheath, which is easily done by blunt dissection except at the *lineæ transversæ*, where knife or scissors will be required. The uninjured muscle is retracted to the outer side and a longitudinal incision made through the posterior wall of the sheath of the rectus and peritoneum (Fig. 2). The muscle is preserved intact with its nerve and blood supply undisturbed. This incision may be placed over any portion of either rectus muscle and may be extended in either direction if the need should arise. While this incision has been the result of a gradual development with us and has proven very useful in our work, we wish to state, in order to forestall controversy, that in looking up the literature we have found it described before.

A short muscle- and fascia-splitting incision may be made over the gall-bladder for a cholecystostomy, by making the incision diagonally from above downward and outward through the skin, fat, and anterior wall of the sheath. The rectus may be split longitudinally with forceps, or retracted outward, and the posterior wall of the sheath and peritoneum may be perforated with forceps and split (Fig. 3). The fibres of the posterior wall split easily in a diagonal direction. This has all the advantages of a strong closure in the upper abdomen that the McBurney incision has in the lower abdomen. The drainage tube may be brought through the incision or through a separate stab wound. We prefer the latter method. This incision is applicable only in patients where an incision has been made at some other location through the abdominal wall and the size, position, and condition of the gall-bladder are known. It is not large enough to permit a cholecystectomy with the latest technic. If an inflamed gall-bladder, containing stones, is found incidentally during a pelvic or other abdominal operation, the condition of the patient at the end of the operation may prohibit anything but a cholecystostomy at that time. If the gall-bladder is large enough to permit the fundus to be brought close to the abdominal wall, this short muscle- and fascia-splitting incision may be used. It will thus be seen that its use is extremely limited. This incision was described by Collins<sup>2</sup> in 1909 and re-described by McArthur<sup>3</sup> in 1915. McArthur advises incising the posterior wall of the sheath of the rectus, but this is not necessary, as its fibres are easily split.

Without entering into a discussion of the relative merits of and indications for a cholecystostomy and cholecystectomy, it may be definitely stated that at the present time cholecystectomy is the operation of choice. It is manifestly impossible to cure a chronic inflammation



in an almost closed sac by a few days' drainage through its top, and this has led to a change in the technic of a cholecystostomy.

In the early history of cholecystostomy one of the results the surgeon dreaded was a permanent fistula. This was caused, sometimes, by the practice at that time of suturing the edges of the gall-bladder to the aponeurosis which frequently permitted the fistulous tract to become lined with mucous membrane, but it was more frequently caused by an overlooked stone in the cystic duct. These errors in technic having been remedied, we no longer fear a permanent fistula. This fear of a fistula caused the surgeon at that time to desire a prompt closure of the drainage tract and led to the practice of tucking in the edges of the opening in the fundus of the gall-bladder, so that peritoneal surfaces would come in apposition when the drainage tube was removed and result in a prompt closure of the drainage tract.

We now know that whenever drainage of the gall-bladder is desirable it should be prolonged to get the best results. Therefore, the practice of tucking in the edges of the gall-bladder opening should be abandoned, as advised by Mayo.<sup>4</sup>

In cases where it is necessary to open the gall-bladder and drainage is not necessary, an "ideal cholecystostomy" may be done. We have had three patients in whom a single stone was found, during a pelvic operation, in a gall-bladder which had caused no symptoms, and was without evidence of chronic inflammation. In these patients the gall-bladder was opened through the short split-muscle incision, the stone removed, and the gall-bladder closed. Reports from these patients after a long period of time said they had had no trouble referable to the gall-bladder.

It is better, when possible, as has been pointed out by Judd<sup>5</sup> and others, to remove the gall-bladder from below upwards. In this way the cystic artery can be clamped near its origin and the hemorrhage controlled at the beginning of the removal.

One of the serious dangers of a cholecystectomy is permanent occlusion of the hepatic or common ducts by including them in a ligature or clamp and cutting off a portion of them. Kehr<sup>6</sup> has described various abnormalities in the location of the hepatic duct in its relation to the cystic duct, and shows that the hepatic duct is occasionally very close to the cystic duct and even at times lying below it, which demonstrates how easily this accident can happen in some cases. The only safe way to avoid this accident is to thoroughly expose the cystic duct, which will also expose the cystic artery, and do the ligation under the guidance of the eye.

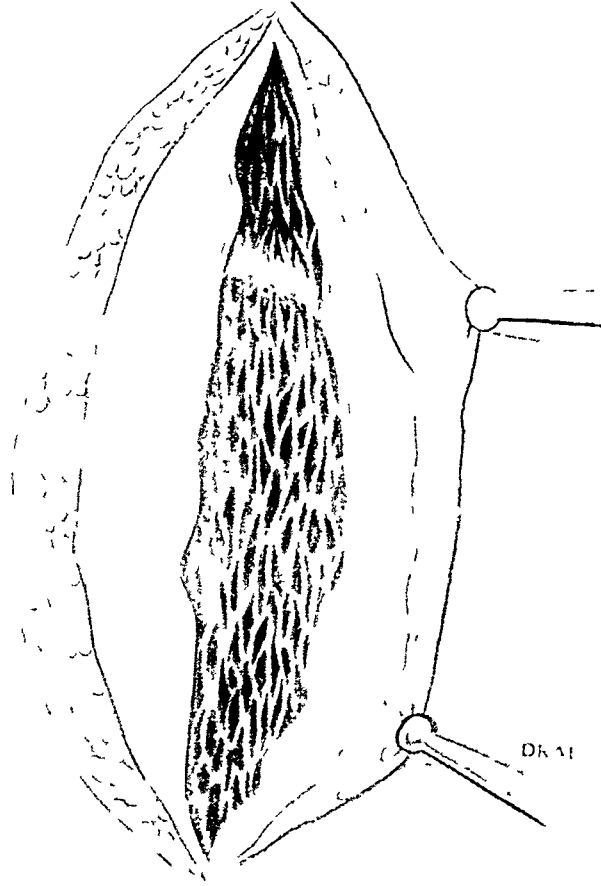


FIG. 1 —Longitudinal incision through skin, fat, and anterior wall of sheath of rectus muscle.

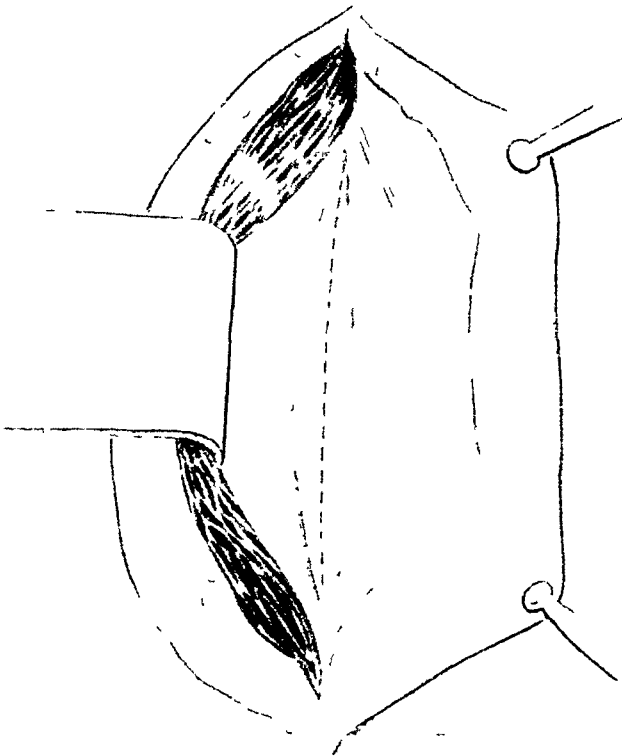


FIG. 2 —The rectus muscle is retracted outward and a longitudinal incision is made through the posterior wall of the sheath and the peritoneum

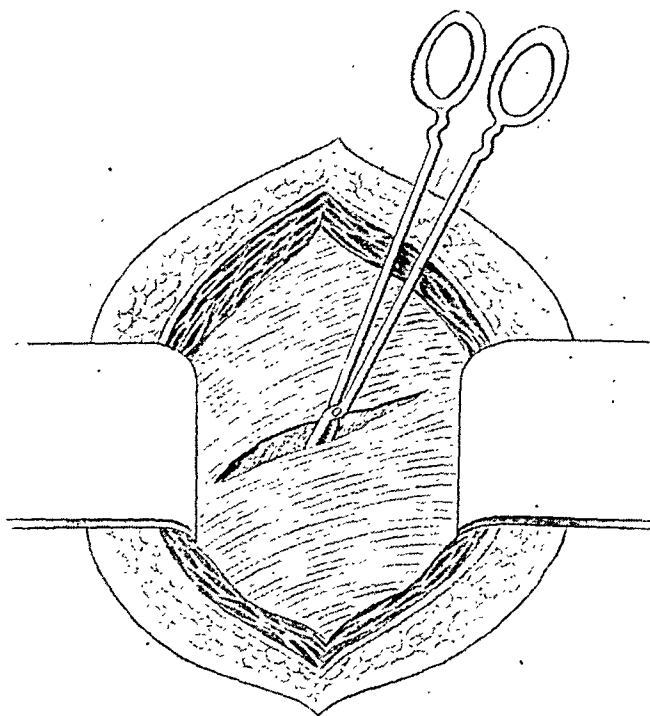


FIG. 3.—Short split muscle incision. The fibres of the posterior wall of the sheath are split by passing a forceps through them.

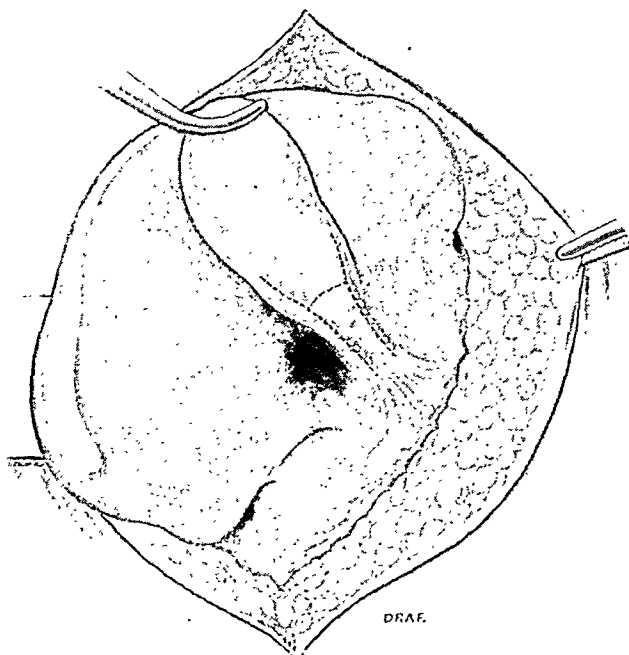


FIG. 4.—A flap of peritoneum is outlined over the lower portion of the gall-bladder and cystic duct by cutting along the direction of the dotted lines.

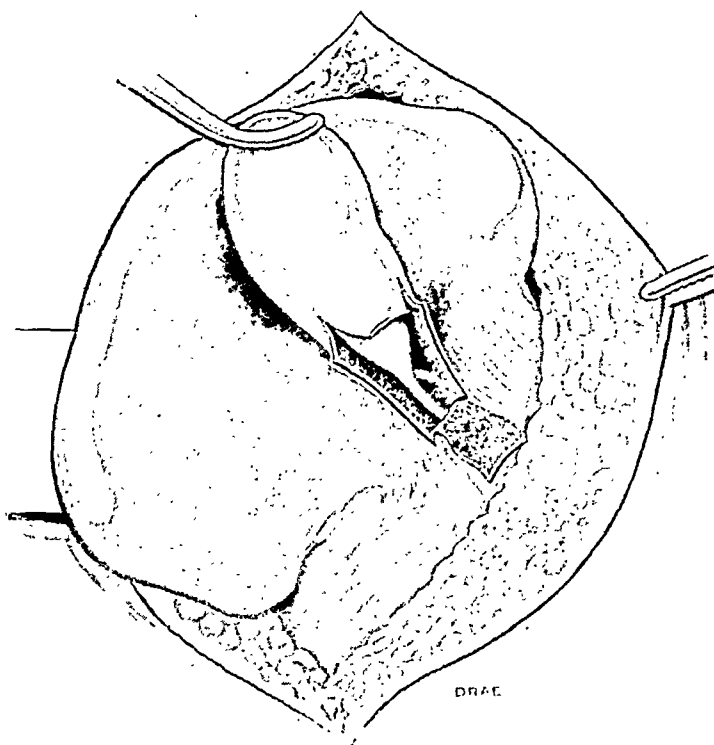


FIG. 5.—The flap of peritoneum is dissected free and turned back, exposing the cystic duct and artery.

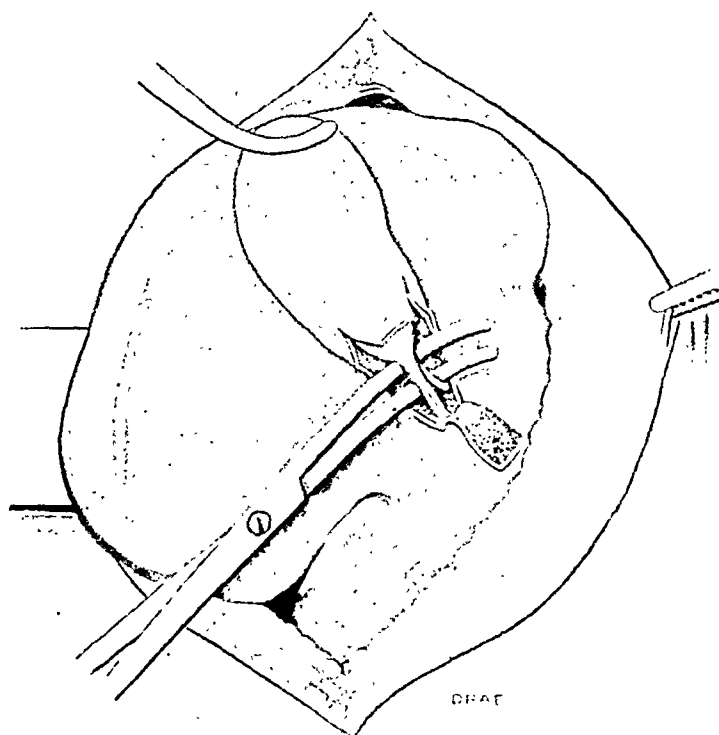


FIG. 6.—A forceps is passed beneath the exposed cystic duct and artery.

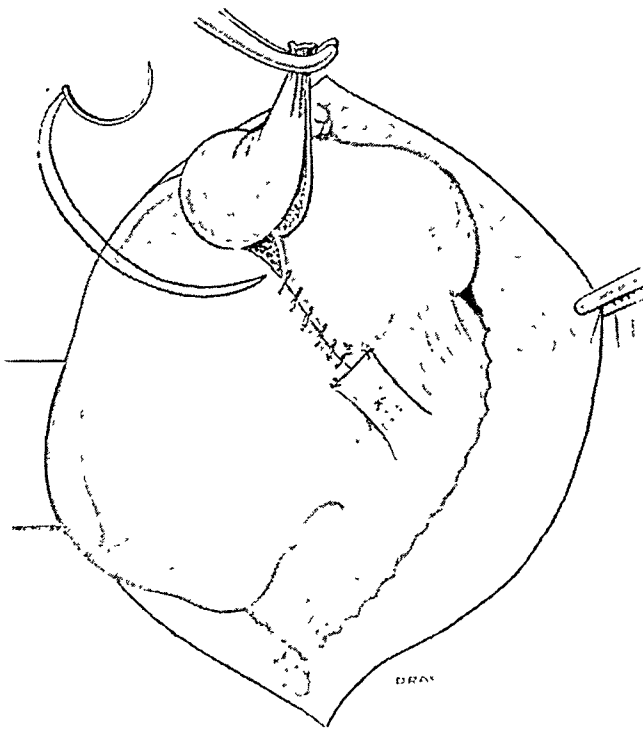


FIG. 7.—After the cystic duct and artery are clamped, cut and ligated, the flap of peritoneum is replaced over the raw surfaces and held in place by sutures.

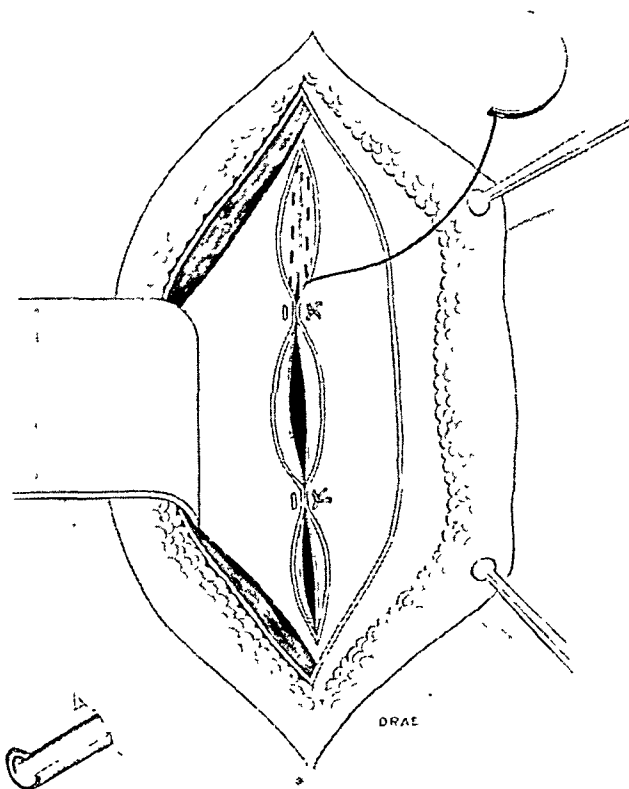


FIG. 8.—The incision in peritoneum and posterior wall of sheath is divided into three or more sections by mattress sutures, which evert the edges of the peritoneum and permit the easy closing of the peritoneal incision by a right-angled continuous suture, which leaves no raw surfaces on the under surface.

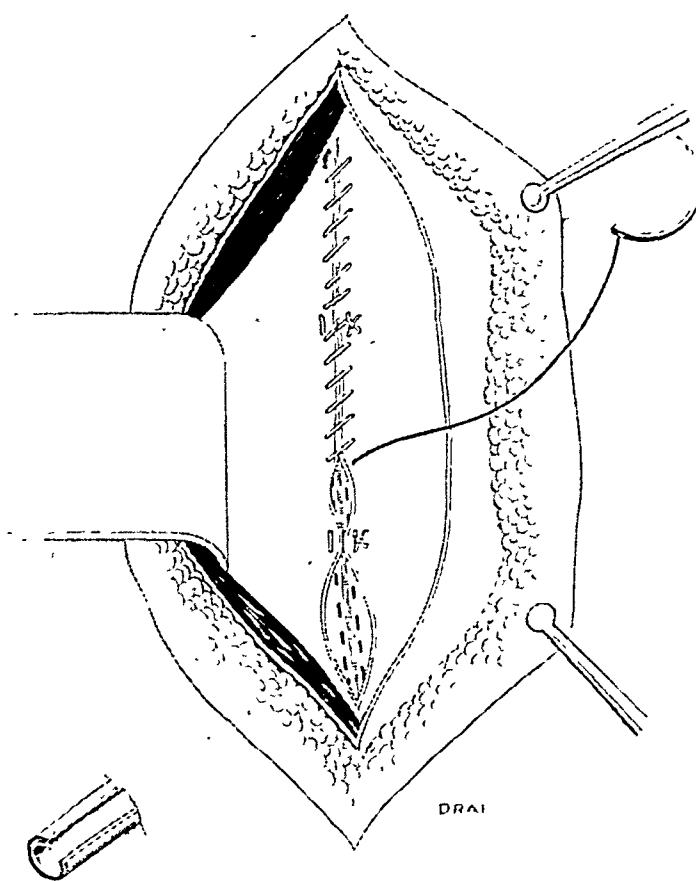


FIG. 9.—The edges of the incision in the posterior wall of the sheath are carefully approximated by a continuous suture.

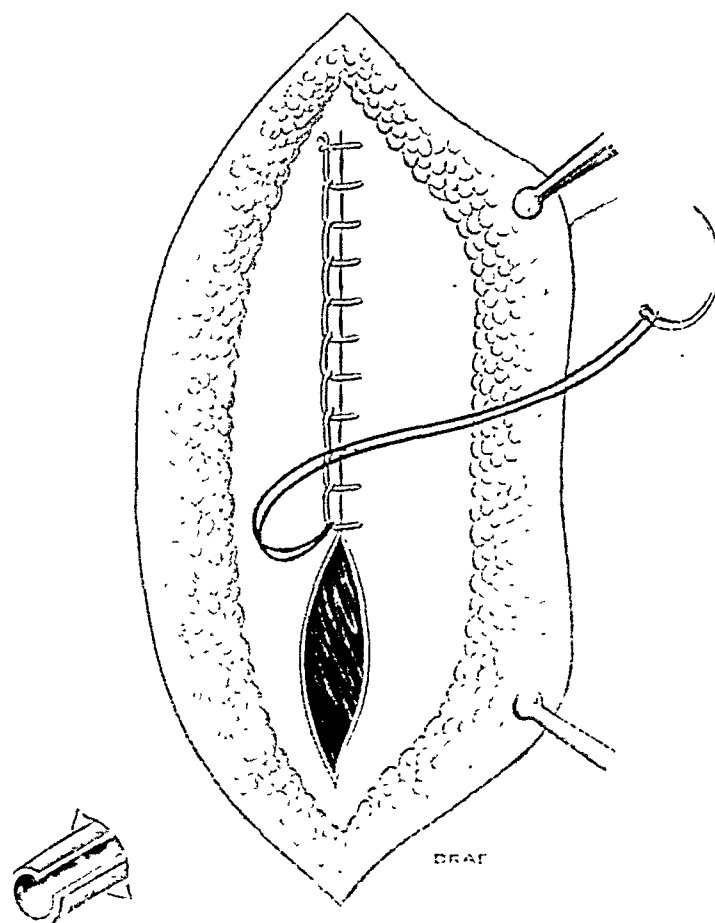


FIG. 10.—The uninjured rectus muscle which has been retracted is allowed to slip into its place and the incision in the anterior wall of its sheath is united by a continuous interlocking suture.



## SURGERY OF THE GALL-BLADDER

A large stone lodged in the lower end of the cystic duct, or partially in the cystic and common ducts, is frequently the cause of occlusion of the hepatic or common ducts during a cholecystectomy. The operator thinks the stone is lodged in the upper end of the cystic duct because the duct is large and dilated behind the stone, and places his clamp and ligature below the stone with assurance. A gradually increasing jaundice after the operation brings the horrifying evidence that the hepatic or common duct has been occluded. If the stone cannot be dislodged and pushed back into the gall-bladder, the duct had better be incised and the stone removed. Then the duct can be exposed and its relation to the surrounding tissues determined. The forceps devised by Colins<sup>2</sup> for removing stones from the common duct is a useful instrument for bringing an incarcerated cystic duct stone up into the incision, where it can be easily removed.

The necessity of exposing the cystic duct and artery to view before ligation and the desirability of covering the stumps with peritoneum caused one of us (Weber) to devise the following technic for doing a cholecystectomy: A rectangular flap of peritoneum is outlined and dissected off from the lower end of the gall-bladder and the cystic duct (Fig. 4). The lower end of the flap is left attached. This thoroughly exposes the cystic duct and artery and permits of their easy isolation from the surrounding tissues (Fig. 5). They can be ligated separately without danger of including the hepatic or common duct in the ligature (Fig. 6). After they are ligated and cut, the flap of peritoneum may be laid back over the stumps and sutured in place, thus leaving no raw surfaces (Fig. 7). The gall-bladder may then be removed and the fissure closed in the usual manner. The flap of peritoneum can be cut large enough to provide for any contraction. If the peritoneum is cut longitudinally over the cystic duct, the peritoneum dissected up on each side contracts so that it is frequently impossible to draw the two edges of peritoneum over the stump of the cystic duct. Frequently the peritoneum only goes one-half or two-thirds the way around the cystic duct, and this makes it difficult to dissect back a cuff sufficiently long to cover the stump of the cystic duct, as recommended by Moynihan. No such difficulties are encountered in making and replacing the peritoneal flap.

Since reading Ruth's<sup>7</sup> article advocating drainage in gall-bladder work through a separate small incision or stab-wound, we have followed that plan. This permits of complete closure of the large primary incision, which must have a tendency to prevent a post-operative hernia.

Probably every surgeon has had difficulty at times in closing the



peritoneum and posterior wall of the rectus sheath in a gall-bladder incision, because of retraction of the edges caused by the side pull of the external and internal oblique and transversalis muscles. It is not best to catch the edges of the peritoneum with two rows of forceps, as has been advocated by Robins,<sup>8</sup> because of the post-operative soreness caused by the crushing action of the forceps on the tender sensitive peritoneum. The edges may be united at two or more places with mattress sutures, which will divide the incision into three or more sections. The edges of these short sections can then be easily united with continuous sutures (Fig. 8). If forceps must be used to facilitate the placing of these mattress sutures, they should grasp the edges of the posterior wall of the sheath only, as this structure is not so sensitive as the peritoneum, which can be closed by a right-angled continuous suture, thus leaving no raw surface on the under side (Fig. 8).

The edges of the posterior wall are closed by a continuous suture, and considerable care is used in closing the edges of this layer, as we believe, with Bartlett,<sup>9</sup> that it is necessary in order to avoid a post-operative hernia (Fig. 9). The rectus muscle is then allowed to slide over into its place and the anterior wall of the sheath is closed with an interlocking suture (Fig. 10). It is not necessary to suture the muscle in any way. In this way the intact uninjured rectus muscle lies between the closed incisions of the anterior and posterior walls of the sheath and there is no continuous incision down through the various layers of the abdominal wall.

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# CYSTS OF THE URACHUS

WITH REPORT OF A CASE

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THE urachus, like all other fetal vestiges, lends itself to changes and disorders which not infrequently bring it to the notice of the surgeon, as well as the pathologist. This remnant of the allantois is situated preperitoneally, running from the summit of the bladder to the umbilicus, directly under the transversalis fascia. It is composed of an inner lining of stratified epithelium, and an outer fibromuscular coat. It is a rather long tubular structure, and hence it is often the seat of multiple dilations of its lumen, which may vary in size from minute to as large as a hazel-nut, but which are of no pathological significance.

Cysts of the urachus of sufficient size to be of surgical importance seem to have been recognized first in 1873, when a case was reported to Wolf. Wutz,<sup>1</sup> however, ten years later argued that the evidence submitted by Wolf was insufficient upon which to base a diagnosis, and that this case was likely not one of urachus cyst.

In 1898 Doran<sup>2</sup> reported a case of his own and appended an extensive review of the subject. He, following closely the views of Wutz, expressed serious doubts as to the correctness of the diagnosis in many of the reported cases, because of the lack of proper histological evidence to support it. He called attention to disease of the peritoneum with ascites as being a reasonable diagnosis, in a few, at least, of the cases.

In fact, the purpose of Doran's exhaustive communication seems to be to dispose the urachial origin of most of these collections of fluid, and from this it appears that the correct diagnosis of certain cases was still in doubt following operation. Even in his own case he is not positive as to the real diagnosis.

In 1906 Weiser<sup>3</sup> collected 86 cases from the literature and by personal communication, which he carefully tabulated as to history, symptoms, and treatment. In this series are included small unimportant cysts and tubular dilations of the urachus, many of which were dis-

covered by accident upon opening the abdomen for other reasons. The majority of his cases of surgical importance were of great size and were undiagnosed prior to operation, either due to their size, or to inflammatory change which confused the symptoms with those of general peritoneal involvement.

As to the origin of urachus cysts, many authors have called attention to a sacculated condition of this structure, due to a lengthening out in places of its attachment to the ventral wall. This, while not uncommon, however, very seldom results in the formation of a large cyst. Therefore, there must be added a patulousness of the tube where it enters the urinary bladder. According to Binnie,<sup>4</sup> in the process of normal obliteration of the urachus these sacculations may persist, as well as small cysts without any further significance. If, however, there remains communication with the bladder, and then there arises some interference with emptying of the bladder, a large dilatation may gradually occur. The communication with the bladder may persist, giving an intermittently appearing and disappearing tumor. Usually, however, due to pressure and the action of the urine, the opening becomes smaller and smaller, until entirely shut off and a permanent tumor is produced.

Most commonly the cyst arises in the lower one-half of the urachus. Those having umbilical communication—about 15 per cent. of Weiser's cases—arise higher up. Rarely are both ends open, although cases have been reported in which the umbilical opening developed secondarily, due to pressure and the influence of inflammatory change.

The cyst may possess a pedicle and be entirely surrounded by peritoneum, or it may be situated in close connection with the abdominal wall, only having its posterior surface covered with peritoneum. As the size increases its identity as a localized tumor is apt to be lost and the whole abdomen become filled with a fluctuating mass, making an accurate diagnosis impossible. Quite frequently the larger cysts become infected, either by extension through bladder communication, or an umbilical opening, or from hematogenous sources. In such cases the symptoms are not unlike those of general peritonitis.

The contents of the majority of cysts is usually a straw-colored or clear fluid of rather low specific gravity, with alkaline reaction. Sometimes it is distinctly urinary and may have undergone decomposition. In those where the lumen has been permanently obliterated for some time the fluid is almost colorless. The enlargement is continued by a secretion from the walls of the cyst which may have been so thinned by the pressure of distention as to have almost lost the identity of the original urachial coverings. It is for this reason that much difficulty

## CYSTS OF THE URACHUS

has been found in confirming the clinical diagnosis by histological examination.

All of the cases reported up to the present can be conveniently grouped into three classes: First, cysts of great size, which occupy considerable space in the abdominal cavity. Second, cysts in which infection of the contents had taken place with the formation of an acute abscess. Third, cysts which present as intermittently appearing and disappearing tumors, due to umbilical or bladder communication.

With the possible exception of the third class, the diagnosis before operation, and even afterward in some cases, can only be guessed, due to the generalized location of the fluid in the first class, and to the masking inflammatory symptoms in the second. It is for this reason, and also to show that not only the very large or infected cysts may bring the patient to the notice of the surgeon, that the following case seems of interest.

CASE I.—G. I., aged thirty-two; farmer; residence, Bremen, Ohio. Physician, Dr. Bradford. Presented himself early September, 1914, complaining of a dull ache in lower abdomen. Inquiry into his family, past and personal history revealed nothing unusual. His present trouble began about three months previous, when his attention was attracted to a soreness in the midline of abdomen three or four inches below the navel. Was carrying a load braced against the abdomen when he first felt the soreness. He paid no attention to this until continued distress upon pressure time after time caused him to be more or less incapacitated. Only deep and firm pressure such as would be produced by lifting heavy objects against his body annoyed him. It was at this time that he first thought he could feel a lump. Finally, in the next two months, after working steadily during that time, the pain grew worse and assumed a constant dull, aching character whether he was at work or not. Once or twice he had an acute colicky attack. The tumor after the first notice remained but increased slightly in size. To the dull, aching pain there was added a rather pronounced tenderness on any kind of pressure. He stated that a semi-stooping position when walking was the most comfortable for him. There had at no time been any discharge from the umbilicus, nor had the flow of urine ever been increased. Bowels were regular.

*Physical Examination.*—Patient was a fairly well nourished male of good color. All examinations except that of abdomen negative.

In the midline below the umbilicus through wall of only medium thickness could be palpated an ovoid mass about ten or

twelve centimetres in length. This almost filled the space between the symphysis and the navel. It was discrete and could be moved laterally in either direction, but always returned to its original position. It could not be moved up or down, and could only be displaced into the abdomen as the walls were pressed inward. The movement up and down seemed to be limited first by the firmness of the attachments, and second by pain caused either above or below, as the mass was moved in the opposite direction. The lateral movement gave one the impression of a swinging motion that would come from the tumor being fixed to the abdominal wall by only a part of its circumference. It seemed that a fluctuation wave could be felt, but this was not positive. The umbilicus appeared normal. Tenderness upon manipulation of the mass, while not unbearable was marked. Otherwise the abdomen was negative.

A diagnosis of "cyst of the urachus" was made, and operation advised for its removal. Under ether anæsthesia the abdomen was opened by an incision slightly to the right of the mid-line, in order to avoid opening into the cyst cavity should the diagnosis be correct. The peritoneum was opened, and to the left was found hanging down into the abdominal cavity a cystic tumor (Fig. 1), recognized by its transparency, covered with peritoneum and having an attachment to the ventral wall about three-quarters to one inch wide. This attachment extended throughout the entire length of the tumor.

After exposing the peritoneum on the opposite side, it was incised and freed, the portion covering the tumor being undisturbed. The cyst then occupied a position in the middle of the incision, supported by its upper and lower attachments. These, when examined closely, were found to terminate at the umbilicus and bladder, respectively. The urachus was made out above, and when followed down seemed to blend into the wall of the cyst and could be picked up again at the lower pole of the tumor. The remainder of the attachments consisted of peritoneum, preperitoneal fat and obliterated hypogastric vessels. Both ends were ligated and the cyst removed.

The abdomen was closed in the usual manner, and the patient made an uneventful recovery, leaving the hospital in two weeks.

Examination of the cyst showed it to be very thin-walled, with numerous small blood-vessels traversing its surface. Its size was 11.5 x 8 x 8 cm., and it contained about 200 c.c. of a clear, straw-colored fluid. This was of alkaline reaction and albuminous in character.

Histological study of a portion of the wall of the cyst near the one pole revealed nothing except its fibrous structure.



FIG. 1.—Cyst of the urachus, removed in Case I.



## CYSTS OF THE URACHUS

This case seems to have been a true cyst of the urachus, as its situation and its relation to this structure both above and below would hardly bespeak any other condition.

A point which must be emphasized in the treatment is extirpation *versus* incision and evacuation of the contents, with subsequent drainage. In only eight of Weiser's cases was extirpation made. This may have been due both to the great size of the cysts and the obscurity of the diagnosis. In the large cysts it is doubtful if complete removal can be successfully practiced, especially if the contents have become infected. The smaller ones, however, of which this case is an example, do certainly permit of such procedure and care in attacking such a case will greatly simplify the treatment.

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# A TRANSPLANTABLE CHONDRO-OSTEOSARCOMA IN A DOG

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AND

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SPONTANEOUS neoplasms of rodents—particularly of the mouse and rat—have been successfully transferred to other animals of the same breed and are apparently capable of continuous growth for an indeterminate number of generations. Attempts to propagate tumors of other mammals have, for the most part, met with but partial success, owing to the fact that growth of the transplant usually ceases shortly after the transfer. Then regression takes place and the tumor disappears in the first or second generation.

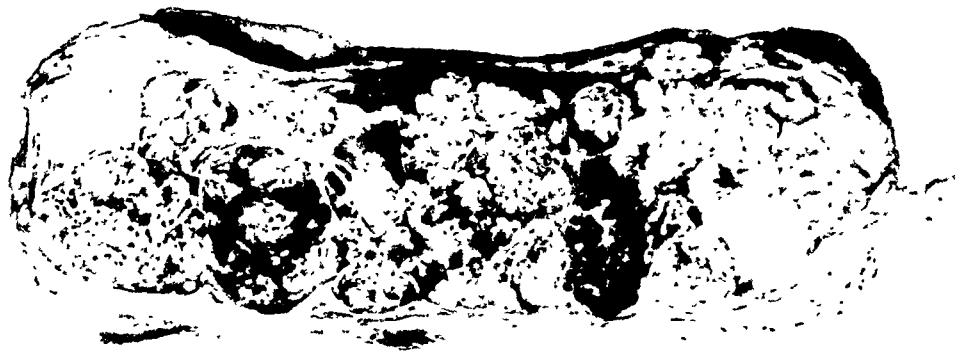
This paper records the successful transplantation, through three generations, of a mammary chondro-osteosarcoma of a dog, in which development of bone was observed in the first generation of transplants.

*Clinical History of Dog with Spontaneous Tumor.*—On February 23, 1914, a dog, the property of Mr. S., was admitted to the Animal Hospital of the Department of Surgery with the following history:

Breed: Wire-haired fox terrier. Sex: Female. Age: Eleven years. Present history: Eighteen months before admission to the hospital, a small nodular mass was noticed in a mammary gland of the left lateral region. The growth had been extremely slow until a month before admission, when it had rapidly increased in size until it reached such proportions as to interfere with walking. Previous to the period of rapid growth the dog seemed well, but from then on her general condition rapidly deteriorated.

*Physical Examination.*—The tumor mass was irregular in outline and roughly spherical, measuring about 10 cm. in diameter; it was loosely adherent to the skin, but freely movable on the deeper structures. In the left cervical region a second tumor was found which measured about  $4 \times 3$  cm., apparently it was not connected with the mammary tumor and was not observed until the period of rapid growth of the latter.

*Operation.*—The primary tumor was excised with aseptic precautions under cocaine anæsthesia, by Dr. St. John, on February 27, 1914. It was somewhat lobular in form, well encapsulated, and only loosely adherent to the deeper structures. No evidence of infection was present. The dog made a good recovery from the operation and was taken home five days later, but the next day it was



0 10 20 30 40 50 cm

FIG. 1.—Surgical Pathology No. 2884. Gross-section of primary tumor.

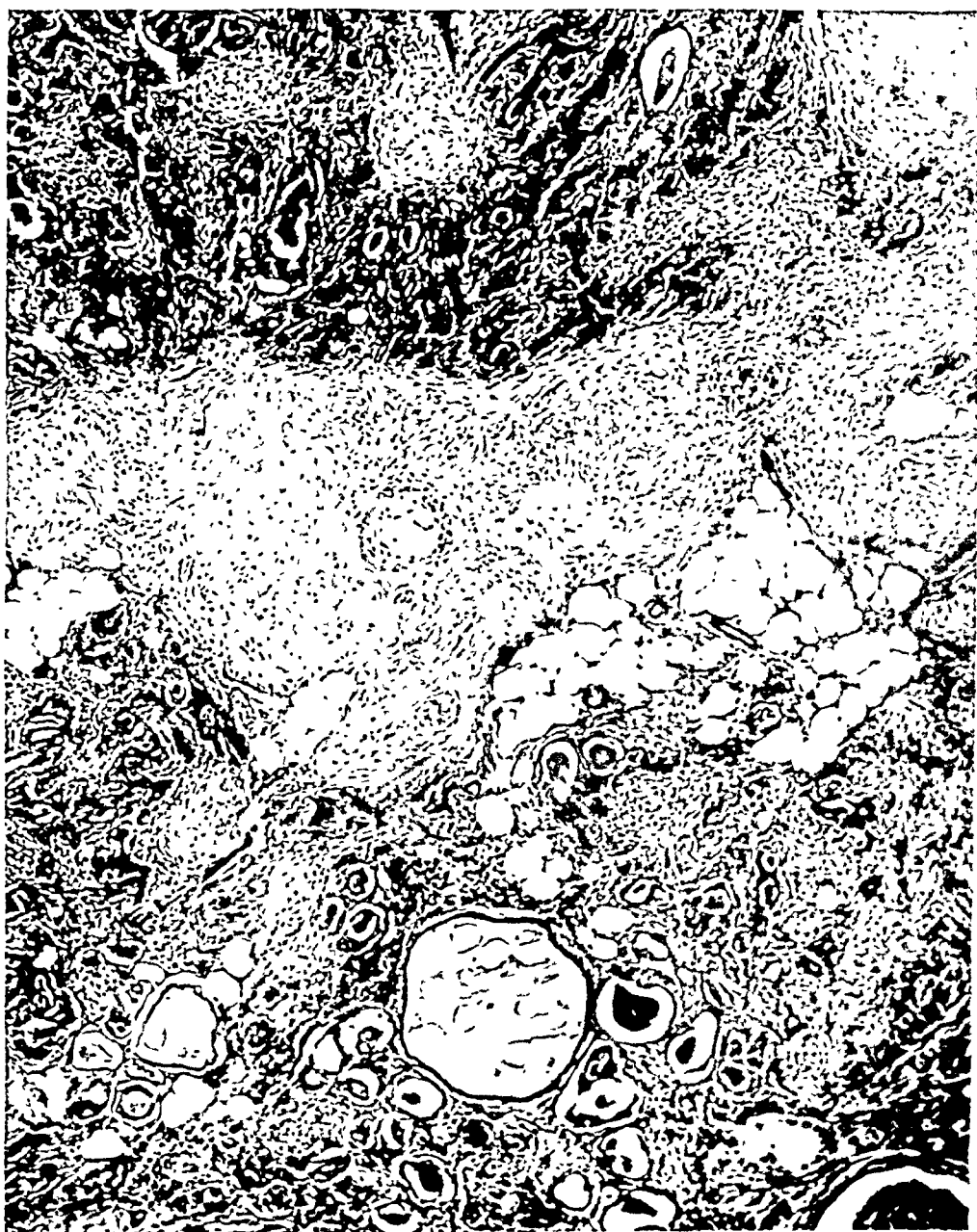


FIG. 2.—Surgical Pathology No. 2884. Primary tumor showing distribution of epithelial, sarcomatous tissue and glandular structure.



FIG 3 —Surgical Pathology No 2884 Primary tumor showing junction between cartilage and hyperplastic glandular tissue.



FIG. 4.—Surgical Pathology No. 2956. Tumor showing necrosis of carcinomatous tissue except in neighborhood of capillaries.

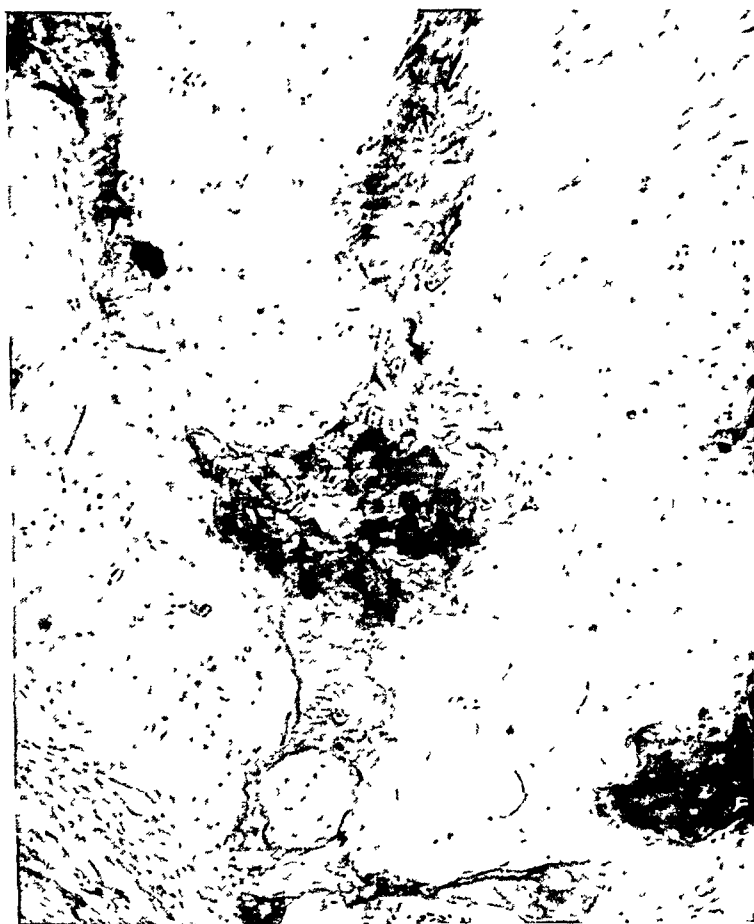


FIG. 5 —Surgical Pathology No. 2953. Section showing formation of bone in transplant.

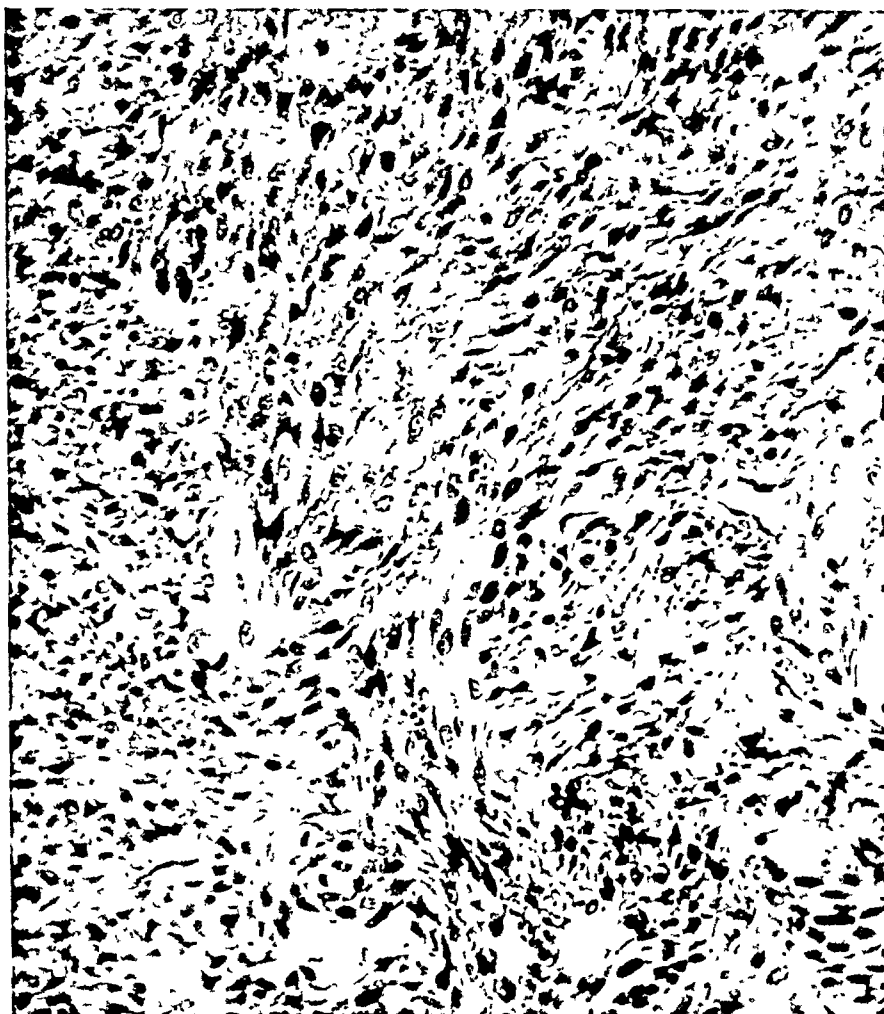


FIG. 6.—Surgical Pathology No. 2945. Section showing arrangement of connective tissue cells in transplant.



FIG. 7.—Surgical Pathology No. 2978. Section showing cellular arrangement in second generation of transplant.

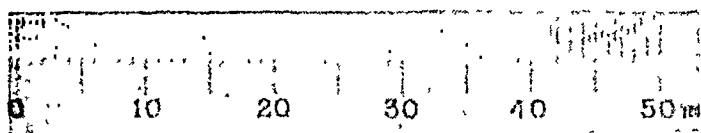


FIG. 8.—Surgical Pathology No. 3000. Gross appearance of transplant from second generation.

## TRANSPLANTABLE CHONDRO-OSTEOSARCOMA

said that she fainted and was chloroformed by her owner. No autopsy was obtained.

*Description of Primary Tumor.*—Macroscopic appearance (Surgical Pathology No. 2884, Fig. 1): The specimen consists of a well-encapsulated, lobulated mass of tissue, roughly spherical in outline, measuring  $9.5 \times 10$  cm. The capsule is rather thick and very dense. On cross-section the entire mass is firm and very dense, some areas cutting like cartilage, while others are of bony consistency. The cut surface presents a variegated appearance, suggesting that the tumor is made up of many types of tissue. Some areas show dilated spaces filled with an amorphous substance, others a mass of tissue projecting from the wall into the lumen, still other regions, because of their hard consistency and gritty feel, suggest spongy bone. Scattered here and there through the structureless tissue of the stroma are small areas which resemble cartilage in appearance and density.

*Microscopic Examination* (Figs. 2 and 3).—Sections show the glandular tissue in some areas to be compressed, the epithelial cells hypertrophied, and for the most part vacuolated. Many of the acini show a heaping up of these cells, with the production of a papillary outgrowth from the walls into the lumina; this cellular arrangement is orderly and shows no tendency to infiltration. In other areas the acini are widely dilated and contain an amorphous substance, staining deeply with hematoxylin. These glandular areas are generally surrounded by zones of round-cell infiltration. Extending outward beyond the mammary gland and abutting upon the lobules of the breast is a mass of dense connective tissue which becomes denser where it meets the intralobular septa. Beyond this margin the tissue is more cellular and is of a much looser structure.

These cells, for the most part spindle-shaped, are rapidly proliferating, as evidenced by their intense staining and the number of mitotic figures. This mass of connective tissue in some areas becomes less cellular and long fibrous strands project from it, interweaving with other strands, to form zones of dense fibrous tissue. The cells lying between these strands have lost their spindle shape and become stellate. This tissue gradually merges into fibrocartilage.

Other sections show the connective-tissue cells to be more rounded than oval; more of the oat than the spindle shape. In many of these areas are scattered nodules of spongy bone.

The formation of bone seems to be one of the characteristics of this tumor; it is scattered generally throughout the connective-tissue stroma; but neither the type nor the arrangement of these connective-tissue cells seems to have any definite influence on its formation. The chief elements of this neoplasm therefore are: (1) Sarcomatous tissue; (2) spongy bone; (3) cartilage.

*Transplantation of Tumor.*—When the tumor was excised several bits of tissue were taken at random from the mass for transplantation.

The technic of transplantations was in all cases the same. The tumor was placed in a sterile dish, and thin slices were cut through the apparently malignant portions. Fragments from these areas were cut into pieces about 0.02 Gm. in weight, and were introduced through an inoculating needle subcutaneously into the axillary regions.

The original tumor was inoculated into both axillary regions of twenty dogs, five of which were part terrier, and not of exactly the same breed as the original dog. Four of the five were puppies and were inoculated on the day of birth. One month later it was found that five of these twenty dogs had developed tumors,



two of which had been inoculated on the day of birth (cf. Chart I). Of these there were three females and one male, while in one the sex was not recorded. One dog of this group died before the tumor was removed. From a second dog, an adult female, the tumor was removed and inoculated in both axillary regions of twenty dogs. At the same time an attempt was made to grow some of this tissue in plasma, but without success. A week later the tumor in a third dog had disappeared.

The growth in one of the two puppies, however, had increased enormously, measuring  $3.1 \times 2.7$  cm. This was removed thirty-nine days after inoculation and transplanted into both axillæ of six other dogs. The second puppy with a tumor died at the end of forty-four days, and as the tumor was decreasing somewhat in size it was not transplanted into other dogs.

In the second series of the second generation (cf. Chart II) the transplants at the end of seven days showed growth in five out of six dogs; in three of these the tumor appeared on both sides. Four of these animals were males and one was a female. These tumors were not as large as those in the previous generation, nor did they grow as rapidly. At the end of a month all but one had disappeared. One was inoculated at the end of eleven days into seven young dogs but did not proliferate in the new hosts.

The first series of the second generation of transplants (cf. Chart III), showed at the end of three weeks tumors in three female dogs out of twenty inoculated, one of which had nodules on both sides. Seven days later another dog of this series had developed a growth, and seven days after this the last tumor of this series was found in a male dog. One of the neoplasms from the dog which had developed a growth on both sides was inoculated with negative results into both axillary regions of twelve dogs. The tumor on the other side was left *in situ* and disappeared at the end of another month. Another tumor of this series which was beginning to retrogress was partially removed and inoculated without success into both axillæ of ten dogs. The portion left in the host soon disappeared.








Under the existing conditions, three months after the tumor had been removed from the original host, the tumor strain died out. During this period it was carried by transplantation through three generations.

*Description of Transplanted Tumors.*—Of the first generation of transplants, three tumors have been selected for description, as they fairly represent all the growths in this series. Surgical Pathology Nos. 2963 and 2956 were growths in puppies one day old, the results of transplants from the original host. These puppies, though not of the same breed as the original dog, were, however, closely related, as their mother was partly terrier.

Surgical Pathology No. 2545, a tumor growth in an adult dog, planted with the same tissue and at the same time as 2963 and 2956. This animal was not a true terrier, although it undoubtedly had some terrier blood. Tumor 2956 was removed thirty-eight days, 2963 forty-four days, and 2945 thirty-one days after transplantation.

Surgical Pathology No. 2956. Macroscopical appearance. The specimen consists of a well-encapsulated mass somewhat lobulated and oval in outline, measuring  $5.5 \times 3$  cm. On section it is found to be made up of dense tissue that extends from the surface inwards for about 1 cm. The centre consists of a soft friable mass, probably degenerative tissue; elsewhere as the knife passes through the tumor a number of areas are encountered which have a hard gritty feel.

# TRANSPLANTABLE CHONDRO-OSTEOSARCOMA

	31		36		45		DAYS
	L	R	L	R	L	R	
1	 †	—					
2	 TFL 2748	—	—	—	—	—	
3	—		—	—	—	—	
4	—	 2956	—	 TFL			
5	 2963	—		—		†	

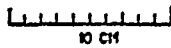






















CHART I.—First generation of transplants.

	7		14		21		28		DAYS
	L	R	L	R	L	R	L	R	
1								—	
2		—		—	—	—	—	—	
3		—	—	—	—	—	—	—	
4					 2962		—	—	
5	 2770		 TFL	 TFL					

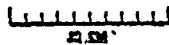


CHART II.—Second series of the second generation of transplants.

*Microscopical Examination* (Fig 4).—Sections show the tumor to be only partly encapsulated. The capsule is made up of a thin layer of connective tissue containing many newly-formed blood-vessels. The stroma of the tumor is composed chiefly of spindle-shaped connective-tissue cells which are densely

# McWHORTER AND PRIME

	21		28		35		42		49		DAYS
	L	R	L	R	L	R	L	R	L	R	
1		—		—		—		—		—	
2	 3000		 TPL		—		—		—	—	
3		—		—	 EXCISED	—	—	—	—	—	
4	—	—		—		—		—	 EXCISED	—	
5	—	—	—	—		—	+	—			

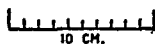
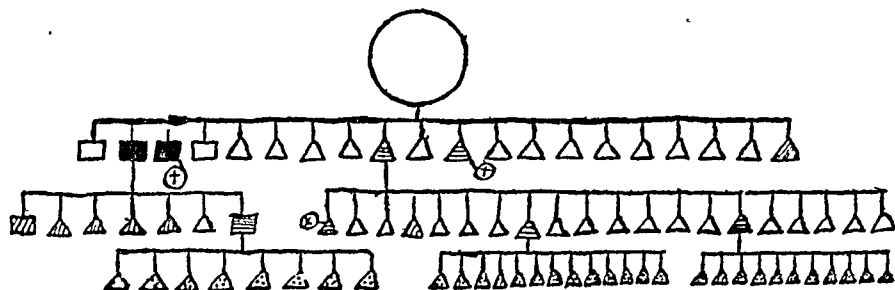


CHART III.—First series of the second generation of transplants.



Pedigree of Transplanted Tumor.

- Primary tumor of original host.
- Puppies transplanted with tumors.
- Adult dogs transplanted with tumors.
- A progressive tumor
- A regressive tumor
- Dogs in which the tumor strain died out. The exact number of takes in this series was not recorded, as the initial growth soon gave way to regression and complete disappearance.
- Animal died.

CHART IV.

## TRANSPLANTABLE CHONDRO-OSTEOSARCOMA

packed together near the surface, and are apparently growing very rapidly. Toward the centre the cells are much more loosely woven and are more round than spindle; and by their intense staining show evidence of high activity. The centre is made up of broken-down cells, lymphocytes, red blood-cells, and fibrin. Scattered at irregular intervals throughout the tumor and situated far beneath the surface are areas of spongy bone. The tumor as a whole shows many newly-formed blood-vessels throughout the stroma.

Surgical Pathology No. 2963. Macroscopical appearance. Specimen consists of an oblong tumor mass, measuring  $2 \times 1$  cm., regular in outline, and well encapsulated. On section the tissue is dense, cuts with difficulty and has a decidedly gritty feel.

*Microscopical Examination* (Fig. 5).—Sections show the tumor to be well-encapsulated. The thick capsule of the tumor is made up of dense connective tissue. Beneath the capsule are areas of calcification, from which strands of very densely packed connective tissue extend inward toward the centre of the tumor. As they approach the centre, the strands become less dense and finally merge into a loosely scattered mass of connective-tissue cells. This picture shows beautifully the transition between the loosely scattered connective-tissue cell and spongy bone.

Surgical Pathology No. 2945. Macroscopical appearance. Specimen consists of a small partially encapsulated tumor mass measuring  $1.5 \times 0.75$  cm. On section it is firm, cuts easily and apparently is of the same consistency throughout.

*Microscopical Examination* (Fig. 6).—Sections show tumor to be only partially surrounded by a capsule consisting of a thin band of connective tissue, the stroma being formed of connective-tissue cells of the spindle type. Toward the centre of the tumor there is a small circumscribed area consisting of degenerated cells. The tumor infiltrates the surrounding tissue through breaks in the capsule, and its growth is very active as may be seen from the number of mitotic figures. This tumor is moderately vascular. There are a few vessels in the stroma, but the greater number are situated near the periphery.

*Second Generation of Tumors*.—The tumors developing from transplants taken, at the time of excision, from 2956 and 2945, were selected for description because they are typical of this series.

Surgical Pathology No. 2978. Macroscopical appearance. This growth, the result of plants taken from 2956, is an encapsulated mass measuring  $1.65 \times 0.6$  cm. On section it is found to be firm and of homogeneous consistency throughout.

*Microscopical Examination* (Fig. 7).—Section shows tumor to be surrounded by a capsule of dense connective tissue. The stroma consists of a densely-packed mass of spindle-shaped connective-tissue cells showing a uniform arrangement throughout the whole extent of the tumor. The large blood-vessels are confined to the capsule; the stroma is apparently without very abundant blood supply. Although the tumor from which this plant was taken developed bone, in this generation all evidence of it is lacking. The conditions which made possible the development of bone in the tumor of the first generation were apparently the same in the second, with one possible exception, namely, the puppies were considerably older than those of the first generation.

This series then resembles in its growth all the transplanted tumors with the exception of the transplants in two puppies in which bone developed.

Surgical Pathology No. 3000 (Fig. 8). Macroscopical appearance. This

tumor, typical of this group, a transplant from 2945, consists of an encapsulated, irregular, oblong mass of tissue measuring  $2.3 \times 1.2$  cm. On section it is found to be of firm consistency, excepting toward the centre, where it is soft and friable.

*Microscopical Examination.*—Sections show the tumor encapsulated by a thin layer of connective tissue. At one point the capsule has been broken through and the neighboring tissue is infiltrated by the tumor cells. The tumor is made up of irregularly arranged masses of spindle-shaped connective-tissue cells densely packed at the periphery, and much looser as the centre is approached. The centre consists of a homogeneous mass of broken-down cells. This area is completely surrounded by round cells. The tumor is only very moderately vascular; the majority of the vessels are confined to the capsule.

*Third Generation.*—In this generation the tumor strain died out. The transplants were made indiscriminately in adult dogs because of a lack of puppies and dogs of proper breed. Although the majority of these grafts underwent an initial growth, the limit of their proliferative capacity was reached in producing in some cases nodules 1 cm. in diameter. It was remarkable with what rapidity these tumors disappeared, for one measuring more than 1 cm. in diameter was not palpable at the end of a week. The microscopic picture of a regressing tumor may be briefly described as usually consisting of a rim of living tumor cells completely infiltrated with round cells, and having for its centre a homogeneous mass of broken-down cells.

#### SUMMARY AND CONCLUSIONS

1. A mammary chondro-osteosarcoma arising spontaneously in a dog has been transplanted into other dogs through three generations, covering a period of ninety days.

2. By far the most successful growths took place in very young puppies and particularly in those of nearly the same breed as that in which the original tumor grew.

3. The tumor showing bone as found in the puppies of the first generation more nearly resembled the original tumor than did the growths in adult dogs.

Therefore it is not unreasonable to assume that by using very young puppies of the right breed, a tumor strain might be developed similar to that already established in rats and mice.

# A TRACTION BANDAGE FOR REDUCTION OF FRACTURE OF THE LEG

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THE writer has been much annoyed by the inconvenience experienced while applying plaster-of-Paris bandages or moulded splints to fractures of the leg, where traction has to be maintained by an assistant, owing to the fact that the assistant has to let go with one hand or the other at every turn of the bandage about the ankle or foot and in re-grasping the limb compresses and deranges the bandage.

To overcome this disadvantage the writer has tried various "hitches," or turns, of a bandage to be placed about the foot, allowing the assistant to exert traction on the ends of the bandage at some inches away from the foot, thus keeping up a steady and continuous pull; the operator in the meanwhile applying his plaster or splints over the traction bandage and leaving the latter *in situ* at the close of the procedure.

The objection to the usual "hitches," or turns, is that the traction is always too far forward along the foot and never in a line with the long axis of the leg. Furthermore, these turns exert too much constriction and would be unsafe if left incorporated in the final dressing.

The bandage here described overcomes both these objections and has been tried out to the great satisfaction of the author.

The essentials are a good stout canton flannel bandage three inches wide and two yards long; two pieces of felt one-quarter inch thick and four inches wide, one piece to be six inches long, the other four inches. The longer piece of felt is laid across the front of ankle and instep, the other over the tendo achillis. The object of the felt is to prevent discomfort from any wrinkling of the bandage and possible excoriations.

The bandage is applied according to the turns shown in the accompanying drawings. The felt pads are not shown in the drawings in order to avoid confusion.

In Fig. 1 we see the first turn of the bandage—a simple turn about the ankle with a return at the point *B*. This reduplication can be made nearer the heel or further towards the instep, depending on whether we desire the line of pull to be back or front of the malleolus—in the illustration the reduplication is at the line of the internal malleolus. The end *C* is carried across the front of the ankle as far as point *D* (Fig. 2).

Here the bandage again turns back on itself, making a loop at point *D*, and passes again across the front of the ankle and, going completely around the ankle, slips through the loop *D* (Fig. 3) and hangs down for one of the traction ends. The loop *D* must have the same relative relationship with the external malleolus as loop *B* has with the internal malleolus, so that the traction may come true and square. As has been

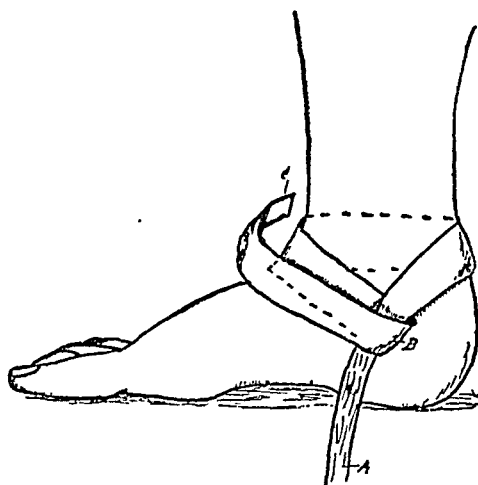


FIG. 1.—First turn, seen from inner side.

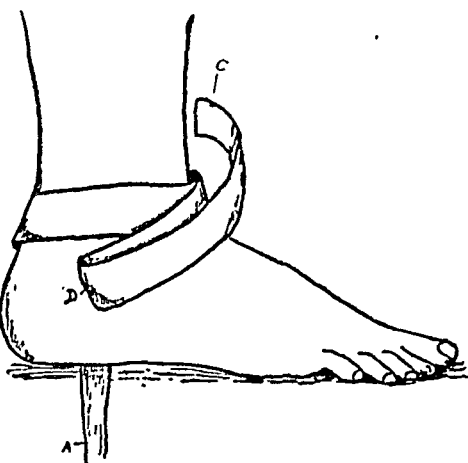


FIG. 2.—Second turn, seen from outer side.

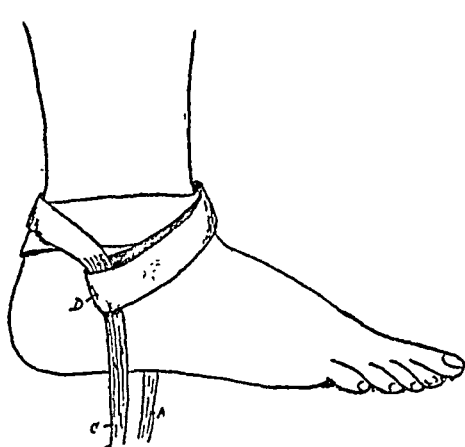


FIG. 3.—Completed bandage, seen from outer side.

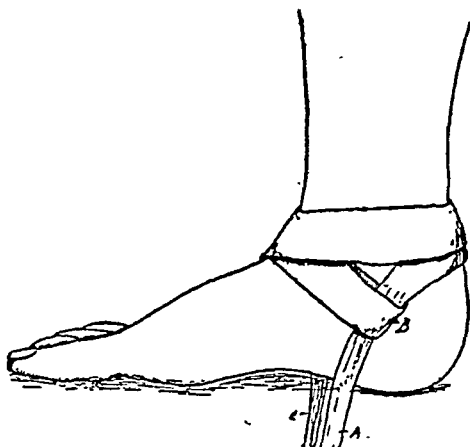


FIG. 4.—Completed bandage, seen from inner side.

already stated, loops *B* and *D* may be adjusted further forward or back to meet the exigencies of the case.

Fig. 4 shows the complete bandage seen from the inner aspect.

Traction is exerted by the assistant pulling on loose ends *A* and *C* (Figs. 3 and 4), and the force pulls in a line vertically through the loops *B* and *D* wherever they may be placed. The bandage with the felt pads is incorporated in the plaster (bandage or moulded splints), and at the

## TRACTION BANDAGE

conclusion of the operation the loose ends *A* and *C* are cut away. With this bandage the pull is exerted in the right direction and the bandage will not slip off the heel.

At first glance a very proper objection may be raised, namely, that we have applied a strong constrictor about the ankle, stopping circulation, and have left the same in place at the conclusion of the operation. There is no question that traction on this bandage will certainly stop venous return, but it is remarkable how instantly and completely the bandage relaxes and loosens itself the moment traction is released. The relaxation takes place even after the incorporation in the final dressing if we exert a little care not to make our plaster too firm over the loops *B* and *D*.



# THE SLIDING GRAFT AND THE KANGAROO SUTURE IN FRESH FRACTURES: ALBEE TECHNIC

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WHEN we speak of operating for fractures, whether for recent, old, or ununited conditions, the Albee methods at once come to mind, and no one, who has had any fair experience, will hesitate to give full credit to the technic that has in many ways placed bone surgery on the sound foundation upon which it rests to-day. There is no doubt but that fractures cause more trouble to the mind of the conscientious surgeon than any other of the many conditions he is called upon to treat, and it is certain that the proper handling of the average case requires study and care on the part of all concerned.

It is only a few months since I heard a surgeon of very large experience, who stands at the very front, and is an authority on fractures, say: "The more experience I have, the more I am afraid of fractures. I dread to see them come in the hospital." If this be the feeling of one who knows the subject, how important for all those whose work is apt to draw this class of cases, to use every means at their command to get as good a result as modern methods and teaching should give, and which will ere long be demanded by those competent to decide.

Previous to October, 1914, our work in the fracture line, while extensive, was not, from any operative standpoint, satisfactory, nor were the non-operative cases a striking success, though functionally the majority turned out very well. Compound fractures, immediately cleansed, and wired, or plated, did fairly well, but often the wires, nails, or plate, acted as a foreign body, and ultimately required removal, and in some cases a curetting for necrosed bone. I am ready, and free to admit, that *faulty technic* was responsible for some bad results, or failures; for all surgeons of experience know, that in no class of cases does *infection occur so easily* as in bone surgery, and further, there is no work that requires such *absolute asepsis*, and freedom from handling. Compared to *opening a joint*, or repairing a fractured bone, working in the abdominal cavity is easy, *as far as infection is concerned*. While the operative treatment of fractures by plates has received an extensive trial by such men as Sherman, Lowman, Walker, and others, the fact that many of these plates have had to be removed, or have

## SLIDING GRAFT IN FRESH FRACTURES

caused non-union, softening, and necrosis, shows that the danger of plating is not to be forgotten.

The work of Albee has progressed so rapidly that the great value of the autogenous graft is now admitted by everyone who has studied this method, while the large number of successful operations has conclusively proved its worth and adaptability. Sherman, and Lowman, at the last meeting of the Pennsylvania Railroad Surgeons, both gave some excellent statistics for the Lane plate, in properly chosen cases, and in their hands some fine results have been achieved; but Dr. Lowman was emphatic in pointing out the weak points of the plate, and was equally enthusiastic in his views of the inlay bone graft, and kangaroo suture; as a most valuable method of treatment, and the *most certain of all in ununited fractures*.

For some months past we have been operating on a number of fresh fractures that have been difficult to reduce, and hold in position, *after a fair trial*. Each case is X-rayed on admission, the patient is then etherized, the fracture reduced, immobilized, and again a plate is made to see the position. Often one view shows an apparently fine condition of the parts, but another view will show poor apposition, hence the importance of taking several skiagraphs. If, after five to ten days, the limb appears to be in good position, as shown by measurement and examination, it is not interfered with, as far as operation is concerned. If, however, there is deformity, or over-riding, we do not delay, but after carefully preparing the skin by cleansing with benzine, followed when dry with tr. iodine, we cut down upon the fracture, making a free incision, and either put in a *sliding graft*, taken from the *upper fragment*, as advised by Albee, and fastening with kangaroo tendon; or, as can be done in most cases of fresh fracture, we put the ends in position by means of clamps, and then fasten them by what we term the "*Albee suture*," that is, two holes are drilled through each fragment in such direction that, when the kangaroo tendons are passed through, they will *cross each other in the medullary canal*, and when tied, will hold the ends of the bone in apposition, without slipping.

In the case of an overlapping, or oblique fracture, the holes are drilled straight through, so that the gut is passed in from one side to the other, then back, and tied on the same side—a *mattress suture*. Two of these are sufficient. The wound is then carefully sutured, and after applying the dressings the limb is put up in plaster-of-Paris. This method applies chiefly to the tibia, humerus, radius and ulna, but we have used it in several fractures of the middle third of femur.

Fractures of the radius and ulna, which are often so troublesome,

are quickly repaired by a single kangaroo tendon passed through a small drill hole in each fragment, and the results are most satisfactory. One of our cases (Figs. 1 and 2) was a young lad of seventeen years, who had fractured his femur *seven weeks previously* to being sent to the hospital; the skiagraph showed wide separation of ends, and considerable callus; the shortening was over two inches. He was prepared for operation, and a long incision made down to the femur. The callus was loosened, and by means of long bone forceps the ends were lifted out of the wound and freshened; double holes were then drilled in each fragment, by the Albee motor, after which heavy kangaroo tendon was passed through the bones, which were carefully forced into apposition, and the sutures tied. The wound was then closed, and the entire limb put up in plaster. The result was splendid, and the young man walked out of the hospital without crutches, and resumed his occupation on a farm, just one hundred and twenty-six days after operation. This case is cited to show the advantage of simple fixation with these heavy kangaroo tendons, followed by plaster cast, instead of plate, or wire. Of course, in an ancient fracture, the inlay graft would be the proper method of treatment. Another case, also shown (Figs. 3, 4, 5 and 6), was one where litigation was expected, owing to the cause of injury: collision between automobile and motorcycle. The young man received a bad fracture of both tibia, fibula and humerus. Repeated efforts failed to get these bones to stay in apposition, and several days after admission operation was performed, and muscle found interposed between the fragments. The Albee suture was used in both tibia and humerus, and after careful closing, plaster-of-Paris was applied. His recovery was uneventful, and his use of the leg is absolutely perfect; the ends of the bones in the humerus moved slightly, but the result is excellent, with full use of arm. I am confident that this case would have turned out badly had the open reduction and suture not been done.

Another case was a young lad who was struck by an automobile, sustaining a fracture of tibia and fibula, with the fragments driven into the muscles. The tissues were greatly swollen, and reduction under ether was only partially successful, as the interposed muscle caused slipping of the ends. After waiting *eight days* for nature to put the parts in the best condition for operation, the fracture was exposed by a long incision, and *sliding inlay graft*, taken from the upper fragment, was put in place, and held by the kangaroo tendons (Albee method). The wound was carefully closed and leg put in plaster cast. The *final result* (Fig. 7) was all that could be desired, and the case

FIG. 1.—Fracture of femur seven weeks before admission. Immediate operation—Albee suture.



Fig. 2.—Showing parts ten days after operation—note callus where ends were separated during operation; leg in plaster-of-Paris. This boy had a practically perfect result when discharged, April 8, 1915. Resumed regular work on farm in June.

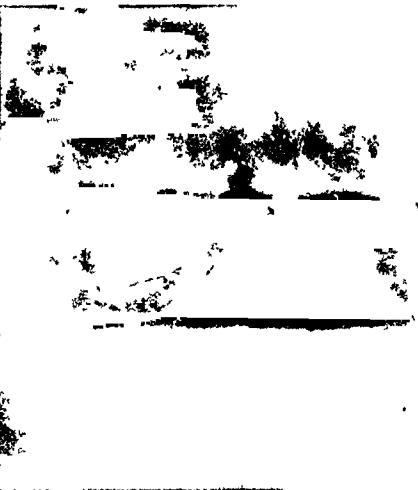
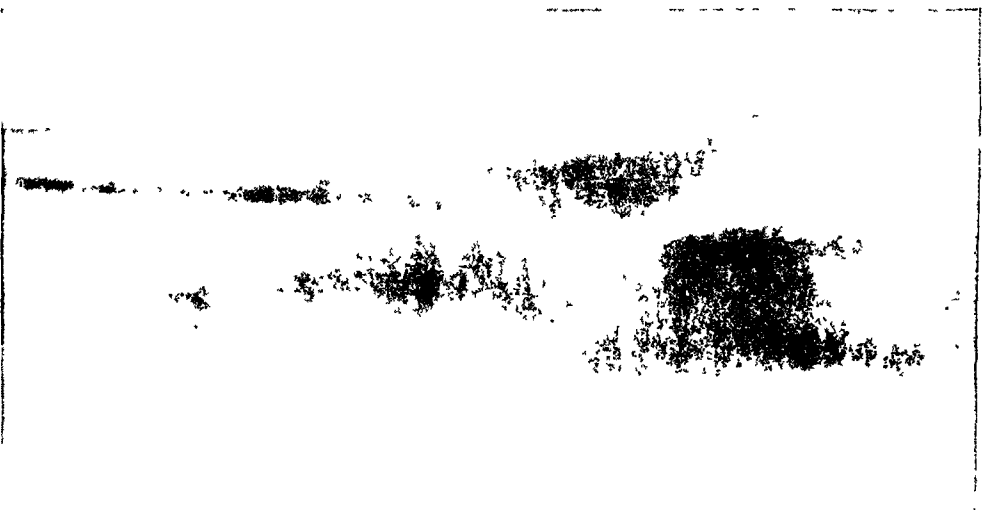


FIG. 3.—Compound comminuted fracture of tibia and fibula. Operation—Albee suture; plaster-of-Paris.



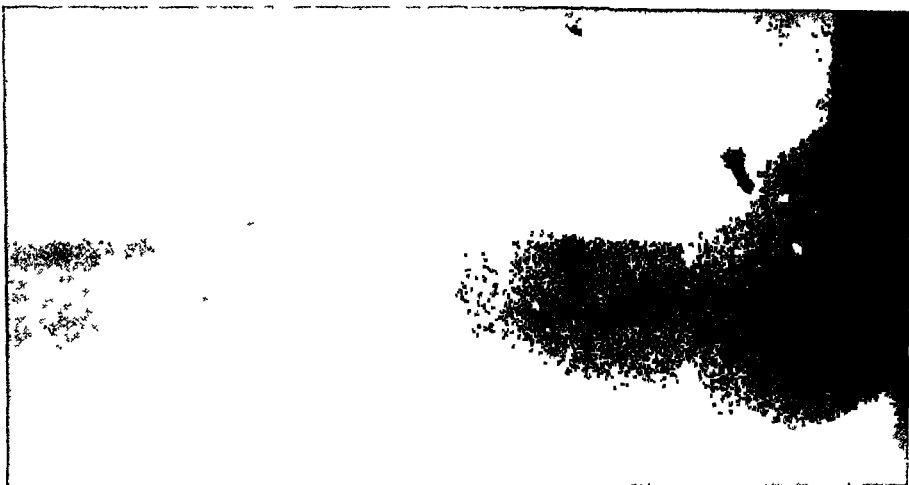


FIG 6 —Operation—Albee bone suture, ten days after operation, muscle spasm moved fragments slightly. Result perfect in every way.



FIG 5 —Fracture of lower third of humerus, fragments imbedded in muscles. Repeated attempts to reduce, under ether, failed. Albee suture performed.

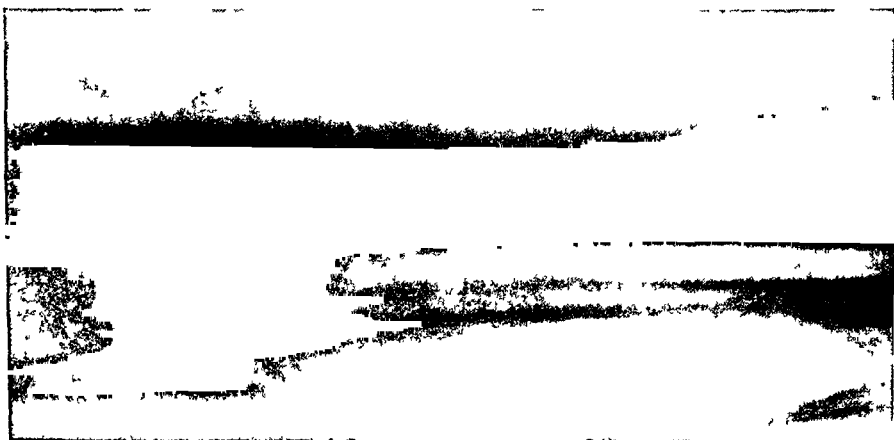


FIG 4 —Operation—Albee suture, ten days in cast. Result perfect—no limp.



FIG. 7.—Fracture of tibia and fibula; fragments imbedded in muscles. Operation—sliding inlay graft. Radiograph shows final result, September, 1915.



FIG. 8.—Patient had hemorrhage and some necrosis; later small abscess, secondary hemorrhage. Operation—inlay graft and bone pegs (first case of inlay graft). Radiograph shows bones six days after inlay graft. Patient now has fairly good use of leg (1916).



FIG. 9.—Comminuted fracture of tibia and fibula.

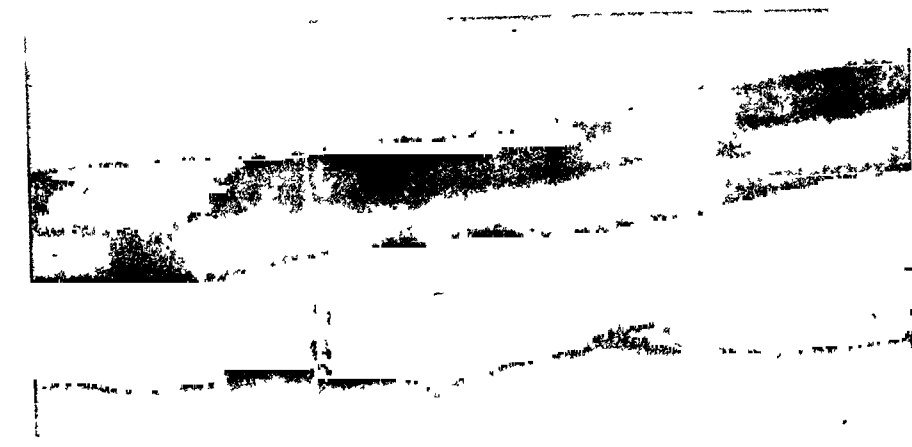


FIG 10.—Operation—Albee suture; plaster-of-Paris. Patient is now (February 1, 1916) perfectly well and has no limp.



FIG. 11.—Compound fracture of tibia and fibula. Operation—sliding inlay graft; plaster-of-Paris. (See also "Bone Graft Surgery," Albee, page 160.)



FIG. 12.—Compound fracture of tibia and fibula treated by Albee sliding inlay graft. Radiograph taken fifteen days after operation.

FIG. 13.—Vicious union of tibia and fibula (left) when admitted, December 31, 1914, with constant pain in foot. Treated by inlay graft. Discharged February 21, 1915, improved.



FIG. 14.—Vicious union of tibia and fibula, fifteen months after accident. Operation—Albee inlay graft; plaster-of-Paris. Nine months after operation patient had excellent result.



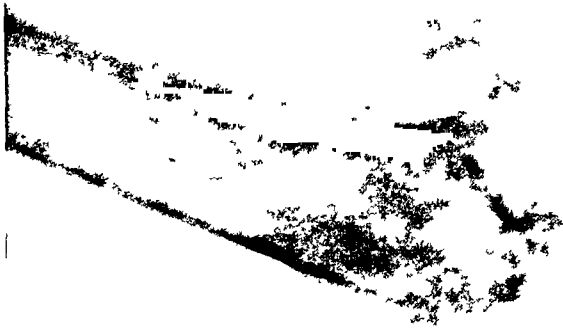


FIG. 15—Old backward dislocation of knee, ankylosis, and deformity (side view, before operation).



FIG. 16—Operation—resection, Albee kangaroo sutures, plaster cast March 20, 1916, primary union of wound, bones united.

## SLIDING GRAFT IN FRESH FRACTURES

was settled out of court for a trifling amount. A remarkable thing about the autogenous graft is its tendency to live and grow in the presence of infection and pus. We have had six cases in which infection occurred, due in some of them to the very bad condition of the parts from crushing, and in which we worked to give the men a fair leg rather than resection, or possibly amputation. In only two cases did we have to remove the inlay graft, which became loose. In one of the cases, after *replacing (twelve days from the first insertion)*, and fastening with kangaroo tendon, the leg continued to drain, but the *graft grew in place*, and the bones united; so the man to-day has firm union. So much for the vitality of the inlay graft.

Our first case, done in October, 1914, was the most annoying of any. This man had his leg crushed by a mass of coal, and his skin and muscles were so torn that it was a case for serious consideration of amputation. After waiting a few days, we decided to suture the soft parts, and put in an Albee graft. This was done, and apparently successfully, but the tissues were so devitalized by his injury that several days later he had a severe hemorrhage, followed by breaking-down of the flesh. The graft held its place, however, though we used bone pegs, and feared they would loosen. Later, after much attention and dressing, he apparently healed and was sent home. He developed a small abscess, and slight necrosis, over two months later; this healed up. The graft became strong, and yet his leg had slight lateral motion. Now, over fifteen months since injury, he walks with the aid of a cane, but has not gotten the strong leg we had looked for. He was also treated in a Philadelphia hospital by a well-known surgeon, who put him on good-sized doses of *iodide of potash*, and, when last seen, the man had improved. I think that this rather tedious case can be explained by the severity of the injury, repeated hemorrhages, and local abscesses; and, further, it was our first inlay operation. The graft, however, was never disturbed, and grew as firmly as possible, and helped very materially to save the leg (Fig. 8).

As Albee has said, the surgical problem which presents itself is not the securing of better fixation, and a more close approximation of the fragment ends by bone removal and freshening (in non-union), but the furnishing of an *efficient internal splint* and at the same time a *bone-growing* and *osteoconductive element* which spans these sclerosed areas, and is at the same time closely and favorably contacted with the healthy, vascular, osteogenetic bone in each fragment *beyond* the eburnated area, and distal to the point of fracture. The inlay bone graft fulfils all these requirements, and even more, in that it acts as a strong

*stimulus to osteogenesis* on the part of the host fragments themselves. While in these non-union cases the graft is usually taken from the tibia, in fresh cases the inlay can usually be taken from the *upper fragment* and *slid into place*. This can be done often in cases of *non-union*, with excellent results, if not of too long standing.

In our last series of fractures of femur, tibia and fibula, and radius and ulna, and patella, one hundred and forty-three (143) in all, we operated in forty-one (41) cases. These were as follows:

Ununited fracture femur (7 weeks) (illustrated) (Albee suture).....	1 case
Fracture of femur (fresh) (Albee suture).....	3 cases
Fracture tibia and fibula (fresh) (sliding inlay graft, Albee).....	6 cases
Fracture tibia and fibula (fresh) (Albee suture).....	11 cases
Fracture tibia and fibula (compound) (sliding inlay graft, Albee).....	1 case
Fracture tibia and fibula (compound) (Albee suture).....	9 cases
Fracture tibia and fibula, and humerus (illustrated) (Albee suture)....	1 case
Fracture of humerus (Albee suture).....	2 cases
Fracture radius and ulna (ununited, 5 months) (Albee sutures both bones) .....	1 case
Fracture of ulna (ununited, 2 months) (Albee suture).....	1 case
Fracture of ulna (ununited, 4 months) (Albee inlay graft).....	1 case
Fracture of patella (Albee suture).....	4 cases

We have had in the wards a series of *two hundred and thirty-two* (232) *fractures* of various bones, occurring between October 1, 1914, and December 31, 1915. Among this number there were:

Fracture of femur .....	24
Fracture of tibia .....	26
Fracture of fibula .....	9
Fracture of tibia and fibula .....	33
Fracture of tibia, compound .....	4
Fracture of tibia and fibula, compound .....	13
Fracture of radius and ulna .....	8
Fracture of radius and ulna, compound .....	4
Fracture of radius .....	4
Fracture of ulna .....	2
Fracture of humerus .....	11
Fracture of humerus, compound .....	1
Fracture of patella .....	4
Total .....	143
Old dislocation knee, resection .....	1 case
Arthritis deformans, knee, resection .....	1 case

This makes *forty-one* (41) cases operated upon out of *one hundred and forty-three* (143), showing, I think, a *fair conservatism*, though

## SLIDING GRAFT IN FRESH FRACTURES

I am free to say that, in view of present conditions, I should have done more "sutures," and *all of the compound fractures of lower leg.*

I hope to report a larger series by the end of another year, and in view of the compensation law, now in effect, there is no doubt but what more will be demanded in the way of shorter periods of disability, and if it is shown that the cases operated upon by the Albee technic do better and are restored quicker than by other means, then the choice will be for that method, but *always under strictest asepsis, and by those qualified to do it, and who are in daily touch with operative technic.*

To sum up, we would state that from our experience in several hundred cases, during the past few years, and having used wires, plates, nails, and later the Albee methods, that the *latter offers by far the best means* by which good results may be gotten, without resort to any foreign body. The simple method of *kangaroo suture* is of vast benefit in cases of fresh, overlapping, or obstinate fractures of arm, forearm, or leg, and in the shaft of the femur can be used with success; while, if desired, the *sliding inlay graft* offers a method whereby success will be gotten in the majority of cases where ordinary reduction is not satisfactory.

*The X-ray should always be used, an anæsthetic should always be given, and attempts to reduce without operation should be made; and, these failing, the open treatment by graft, or suture, is indicated.*

Compound fractures can nearly always be placed in apposition and held by the *kangaroo tendon*. Plaster-of-Paris is the *best means of immobilization*, and should be applied smoothly, being careful to pad the parts carefully.

# FRACTURES OF THE FEMUR \*

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*General Considerations.*—A fracture of any bone of a living human being is not simply “a solution of the continuity of the bone,” but an injury which, in the large majority of instances, is a complex traumatic condition, consisting of the break in the bone and injury to the soft tissues of the part involved, of greater or less severity. In some cases the injury to the soft tissues is of more importance than the fracture of the bone itself; in the majority of cases the injury to the soft tissues is of great importance; and in no instance, except perhaps in the rare cases of so-called “green-stick fracture,” may they be neglected or forgotten in treating the case.

The cause of fractures is usually stated as (a) direct and (b) indirect violence. In civil life fracture by direct violence is comparatively rare. Of 739 cases analyzed 120 were from direct violence and 619 resulted from indirect violence.

I have analyzed the conditions and histories of a large number of indirect violence fractures, and I feel sure, in nearly every instance, the fracture of the bone, if it were a long bone, was produced by incoördinate leverage.

When a human being uses his extremities voluntarily for motion and locomotion he accomplishes these acts by coördinate leverage, the motion to the levers (the bones) being applied by the coördinate use of the proper muscles. If taken unawares, the position of the extremity or the position of the trunk may be such that even slight momentum results in violent incoördinate leverage, and a fracture may result.

As regards the number of fractures in the several age periods, the British and American statistics differ somewhat. They are as follows:

American, No. cases <sup>1</sup> studied, 344.		British, No. cases <sup>2</sup> studied, 716.	
Under 10 years .....	90	Under 10 years .....	394
10 to 20 years .....	65	10 to 20 years .....	155
20 to 50 years .....	122	20 to 50 years .....	77
50 to 70 years .....	55	50 to 70 years .....	90
70 to 90 years .....	12	70 to 90 years .....	0
<hr/>		<hr/>	
Total .....	344	Total .....	716

\* Read before the Philadelphia Academy of Surgery, March 6, 1916.

## FRACTURES OF THE FEMUR

Of 751 American cases <sup>3</sup> reported the kind of fracture was:

Simple .....	708
Compound .....	23
Compound comminuted or complicated ....	20

The combined reports of the American and British cases make the following classification of locations of fractures of the shaft of the femur:

Upper third .....	177 cases
Middle third .....	629 cases
Lower third .....	186 cases
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Total .....	992 cases

The American statistics do not show, but the British classification indicates the prevalence of fractures of the femur in the several regions as regards the age periods, as follows:

1. Fracture of the neck of the femur.

0 to 10 year period .....	4 cases
10 to 20 year period .....	11 cases
20 to 50 year period .....	20 cases
50 to 70 year period .....	67 cases
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Total .....	102 cases

2. Fractures of the upper third of the shaft.

0 to 10 year period .....	66 cases
10 to 20 year period .....	19 cases
20 to 50 year period .....	16 cases
50 to 70 year period .....	33 cases
<hr/>	
Total .....	134 cases

3. Fracture of the middle third of the shaft.

0 to 10 year period .....	293 cases
10 to 20 year period .....	106 cases
20 to 50 year period .....	43 cases
50 to 70 year period .....	40 cases
<hr/>	
Total .....	482 cases

4. Fracture of the lower third of the shaft.

0 to 10 year period .....	35 cases
10 to 20 year period .....	30 cases
20 to 50 year period .....	18 cases
50 to 70 year period .....	27 cases
<hr/>	
Total .....	110 cases

This shows that a remarkable preponderance of fractures of the shaft of the femur in Great Britain occur in childhood.

My own American statistics, not worked out as regards the special regions, show:

5. Fractures of whole shaft considered together. <sup>a</sup>	
0 to 10 year period .....	90 cases
10 to 20 year period .....	65 cases
20 to 50 year period .....	122 cases
50 to 70 year period .....	55 cases
70 to 90 year period .....	12 cases
<hr/>	
Total .....	344 cases

This indicates that the age period of active hard labor has more fractures of the shaft of the femur in America.

*Diagnosis.*—Distortion, "false mobility," great pain and local tenderness, ecchymosis, swelling and crepitus, if all are present in any case, one may easily conclude a fracture has occurred. Sometimes distortion is difficult to appreciate, no crepitus is felt, and there is fixity of the extremity, only great pain and local tenderness are present, perhaps considerable swelling and some ecchymosis. Such cases may be extremely difficult to determine, especially if the lesion be near a joint.

Careful ocular examination and comparison with the uninjured limb, if the uninjured one is a normal member, careful measurements and the gentlest possible manipulation, continued for only a very short time, may be employed. If this does not suffice to establish the diagnosis, fixation in the position assumed by the extremity should be secured and a radiographic investigation by a competent operator should be made as soon as practicable.

Prolonged manipulation and careless handling or forceful attempts to elicit crepitus should always be avoided. The dreadful pain from these methods of diagnosing causes spasm of the muscles, and on account of the incongruous positions which follow may make the determination doubly difficult.

In obscure cases difficult to diagnose, if manipulation is necessary to establish the diagnosis, it should be postponed until the physician is prepared and ready to make his permanent dressing; then a general anæsthetic should be given, if the patient's general condition will admit of it, and setting should immediately follow the manipulation; or, better still, the manipulations should accomplish the setting, and the permanent splint or dressing be applied at once. Much better, however, is it to reach the correct diagnosis by a skiagram or by fluoroscopic examination.

## FRACTURES OF THE FEMUR

I very much doubt that a physician who cannot give his patient the benefit of a well-taken skiagram, or himself be able to make a fluoroscopic examination, should, in these modern days, attempt to treat major fracture cases.

The first thing to do is to find out the condition of the individual as regards his strength, condition of shock, manifestations and result of his pain, etc. The general requirements should first be done, then the special ones be attended to.

Shock in many cases is marked and requires care and discrimination in managing it. The early shock, that which comes on immediately after the injury, is a psychical one, or due to "anoci associations." This is best treated by morphia given in full doses. Persistent or late shock means hemorrhage, as a rule. This may require exploration by incision, and packing of the lacerated cavity, or ligation of bleeding vessels.

Pain and muscular spasm are the special ever-present and overpowering immediate sequel of fractures of the femur. The pain is so severe and trying in many cases it rapidly exhausts the patient. The position of the fragments sometimes aggravates the pain. One should try rapidly and gently to ascertain in a general way whether the fragments are pressing against the skin or the nerves, and place the limb in such a position that this pressure shall be relieved. Then give a full dose of morphia, and immobilize and fix the extremity, unless one is prepared at once to reduce and splint the fracture. In this latter case a general anæsthetic should be given and all manipulations be done in anæsthesia.

In complete fractures of the shaft of the femur there is always more or less hemorrhage. I have seen tremendous extravasation of blood subcutaneously and between the muscles in some cases. One should estimate the severity of the hemorrhage by the tension and general quality of the pulse, and by the size of the hæmatoma about the fracture, and should direct his measures accordingly.

Active stimulation, hypodermo- or proctoclysis, and in a few instances intravenous saline solutions, must be used. Unless the physician has the benefit of a well-equipped operation room and thoroughly aseptic technic he should open the soft tissues only from dire necessity; these instances will be very rare. A tourniquet or elastic bandage should be used only when nothing else avails.

The first aid or preliminary treatment should be only gentle extension and fixation of the limb in extension, until the patient may be taken for his permanent dressing.



Prolonged attempts at reduction, or manipulations for the establishment of the accurate relative positions of the fragments when the examiner is not prepared immediately to put on his permanent or final dressing are reprehensible, because they are unnecessary and brutal.

When the patient must be transported the limb should be fixed in the position in which it is found, unless the fragments are evidently pressing on the skin or on some nerve trunk. In the latter case sufficient variation of the position must be made to relieve this pressure, then the limb should be fixed.

Except in cases of fracture of the neck within the capsular ligament, a general anæsthetic should be employed in manipulating and reducing the fracture. This is best, even in cases where Buck's extension or some variation of the Buck's extension is to be used.

It must always be borne in mind that no two cases of fracture are exactly alike. For this reason the same apparatus cannot without modification be used with different individuals, even though the fracture of the bone seems exactly alike. The apparatus must be adapted to each individual case and not the case to the apparatus.

Fractures of the femur may bring about the death of the injured person. The 760 cases studied showed a death-rate of 3.69 per cent. Shock,<sup>8</sup> pneumonia and delirium tremens following the fracture caused most of the deaths.

*General Management of Fractures of the Femur.*—It should always be borne in mind that text-book statements are at best average statements; they, as a rule, try to note what the ordinary displacements, signs and indications of a particular fracture should be. Usually these statements are based on anatomic and mechanical considerations entirely. The physiologic and pathologic forces are not usually recognized or regarded. For instance, fractures of the upper third of the shaft of the femur are stated to be followed by upward and outward displacements of the proximal fragment and upward and inward displacement of the distal fragment, according to the books, and anatomically it should be so. As a matter of fact, in one case at least, I have seen almost the reverse condition.

Displacements and distortion in every case will depend upon the extent and severity of the injury to the contiguous soft tissues. A muscle which ordinarily should produce a certain special deviation of the fragments may be almost or completely paralyzed by the severity of the injury, and another muscle which ordinarily cannot successfully oppose it may be stimulated to tetanic spasm, and by its superviolence produce an entirely different or widely varying distortion and displace-

## FRACTURES OF THE FEMUR

ment from that the books and ordinary experience have taught us to expect.

Again, most of the innervating nerves may be severed, or the main nerve trunk be almost crushed by the leverage and weight of a fractured femur. Paresis of the muscles may follow; gravity and leverage alone will then determine the displacement. Congenital or acquired previous distortions also influence displacements. Therefore, a safe postulate for handling and treating any case of fracture of the femur is, never take anything for granted, determine each individual case accurately and carefully and treat it according to its individual requirements.

Some years ago I was called in consultation and asked to reduce a fracture of the lower third of the femur in the case of an old man. The physician in charge told me he had tried repeatedly, always unsuccessfully, to reduce the fracture. It was a fracture almost transverse and the old gentleman was rather thin. I thought by etherizing him I should certainly be able to reduce and retain the fracture in place. I was astonished and greatly chagrined to find that my assistant and I by any of the ordinary means and methods could not reduce the fracture. Finally, it occurred to me to examine the uninjured lower extremity. I found the most exaggerated case of bow-legs I had ever seen. This gave me the necessary indication. By changing the direction of the traction and using a fulcrum just above the knee-joint, the adjustment was quickly and easily done.

### TREATMENT OF THE FRACTURES OF THE SEVERAL REGIONS OF THE FEMUR

*Fracture of the Neck.*—This fracture usually occurs in old people or in middle-aged women, unless it is produced by direct violence.

In the senile cases it is commonly intracapsular. When it occurs in healthy adults, the fracture is apt to be near the junction of the neck with the shaft and it is partially extracapsular, especially posteriorly. The last form may be impacted, the former never.

The age of the patient, the history of the case, viz., a sudden trip and fall followed by inability to stand, great pain in and about the hip sometimes running down to and also felt in the knee; extremity easily moved at the hip by manipulation, eversion of the foot, shortening of the extremity, elevation of the trochanter major shown by Nélaton's line or Bryant's triangle, local tenderness, great pain when the extremity is moved, especially when rotation is attempted, will serve to make the diagnosis, provided one may exclude fracture of the pelvis about and including the acetabulum. It is not necessary to attempt to obtain crepitus; to do this is very painful.

The fracture at the junction with the shaft usually shows crepitus by even gentle passive movement. This, in addition to the signs indicated above, will make a diagnosis of fracture easy, but it is not always easy to differentiate between the two, even though one has constantly in mind the fact that crepitus is much more easily elicited in the latter than in the former case. A good skiagram may be necessary to clear up the diagnosis.

*Treatment.*—Senile cases demand attention to their general condition at once. They are usually in shock on account of the great pain produced, and will require full doses of morphia the first twenty-four hours. While it is true that some old people do not stand confinement in bed well, it is not true of all cases by any means. One must early judge this feature and be guided in his treatment by this determination. As a rule, a dressing and apparatus should be employed which will enable the patient to move about a little in bed and to change position from time to time. It is rigid fixation in one position in bed and pain which prove so exhausting to old people. Strong traction and the necessity of remaining fixed on the back are very irksome, and are apt to be painful; hence the ordinary traction devices should not be used for any length of time in cases of old people.

I have found the old Hodgen splint, or the Nathan Smith wire frame splint, most useful in cases of fracture of the neck of the femur.

When the fracture is at the junction of the head and neck, I use more than the 45 degrees of abduction, suggested by Royal Whitman. The injured limb should be swung free of the bed and supported in the Hodgen apparatus, and this, in turn, held by an overhead bar. Traction may be obtained by so arranging the cords which attach the splint to the overhead bar that they are continually drawing downwards, that is, towards the foot of the bed. This is necessary in most cases to overcome the spasm of the muscles and to relieve the grind on the head of the bone.

I have recently treated three unpromising cases in this way with great comfort to the patient, and with a very successful and happy result of the treatment.

For the fractures of the neck at the junction with the shaft, the overhead bar should be only a little obliquely placed as regards the bed, so as to obtain very little abduction. Swinging entirely free of the surface of the bed, suspended, and continually in traction, the limb is comfortable, and the apparatus permits great freedom of movement of the body of the patient and many changes of position. The patient may sit up in bed, and use the bed-pan without difficulty. In a sunshiny,

## FRACTURES OF THE FEMUR

well-ventilated room, near a window, an old person can stand this apparatus in most instances eight weeks without serious detriment.

Cases which will not endure this method of treatment should have adapted an extension apparatus like the Hutchinson hip-joint brace, or the Thomas brace, and be taken out of bed, placed in a comfortable wheel-chair and wheeled into the fresh air. Massage and alcohol rubs are very grateful and useful adjuncts to the treatment.

Some preparation of nux vomica internally, careful feeding, and diversion, are also very useful in these cases.

*Fractures of the Upper Third of the Femur.*—These fractures occur most frequently in childhood (NOTE.—See the last paragraphs under “General Considerations,” page 76), and are the most difficult of all fractures of the femur successfully to treat, without an open operation.

The signs and symptoms are usually quite classical in these fractures; no difficulty is found in diagnosing the fracture, but it is difficult, especially in a stout, fat or full-muscled person, to determine whether the fracture is oblique or spiral. It is nearly always one or the other.

The tilting upwards, and outward rotation of the proximal fragment, may be overcome by general anæsthesia, which relaxes the spasm of the muscles, and one may accomplish a fair restitution of the fragments, but it is very difficult to hold them in proper place afterwards. In children this may be done by a well-applied plaster cast put on in anæsthesia and reinforced by flexible wood strips laid in on the anterior and outer surface, and carefully fitted and snugly applied from the knee to the umbilical region. Occasionally one may succeed with a similar dressing in cases of thin, weak adults, but for strong, robust individuals, in order to preserve the position of the fragments, it will be necessary to employ a system of downward and outward cross-traction, with powerful extension of the extremity by weights, like the Bardenheuer method. I think, however, a better method is to use the Nathan Smith anterior wire frame, curved at the knee so as to obtain flexion at the knee. It should carefully be bandaged in place and then the extremity suspended in a sufficiently rotated position to meet the displaced proximal fragment.

In a recent case, in which there had been extensive superficial lacerations and serious infection, we tried all manner of dressings and positions, without being able to retain good apposition. On account of the infection, no open operation could be employed. The child (nine years old), nevertheless, obtained good union (though the fragments overlapped), and had a perfectly useful limb afterwards. I shall return to this point later on.

As was said before, this is the region of the femur in which, when a fracture occurs, an open operation for replacing and directly plating the fragments themselves is indicated.

*Fracture of the Middle Third of the Femur.*—These are the most frequent of femoral fractures. They are easily diagnosed as a rule. I have no record of, nor can I remember ever to have seen, but one incomplete or green-stick fracture of the femur; this was in this region. Usually fractures in this region are oblique or spiral; they are sometimes transverse, however. The distal fragment is usually drawn upwards above the end of the proximal fragment, but it may lie in any position as regards the horizontal directions. I have seen anterior, posterior, internal and external positions of the distal fragment as regards the proximal fragment. It all depends upon the nature and extent of the injury.

Middle third fractures are usually considered the ones especially requiring some form of traction method for their treatment. Except in a few selected cases, I have quite lost my preference for traction methods of treating these fractures, since skiagrams so persistently showed me overlapped fragments, inaccurate apposition and nearly always a little angulation, as a part of the result. Besides, a stiff, painful knee-joint is apt to persist for many weeks.

For transverse fractures, I have had better results with a plaster-of-Paris fixed dressing, after reduction in general anæsthesia. This should be removed in three weeks, the limb carefully washed with alcohol, massaged, the joints very carefully moved, and another plaster dressing applied.

Also for oblique or spiral fractures, in most instances, the plaster splint applied in complete general anæsthesia is best and most comfortable. These splints should be applied while the limb is powerfully extended by means of a Lemon or a Lambotte apparatus. Manual extension cannot be kept up unvaryingly for a sufficient length of time. If one has the benefit of a first-class modern fluoroscope to see just what he is doing, he will be very fortunate indeed.

For the traction method I have been accustomed to use for many years a modification of the Volkmann leg- and foot-piece to prevent rotation of the foot, and to lessen friction. My apparatus consists of a leg- and foot-piece, which is bandaged to the leg and foot after the adhesive plaster strips have been laid on. Cross-pieces go out on either side from under the leg-piece and ride on two pieces of hard wood planed to a narrow edge. These are made like an ordinary railroad into flat sections, of varying sizes and lengths. This apparatus raises the

leg and foot a little, keeps them off the bed and slides easily in the running grooves on the track of hard wood. When properly applied the apparatus keeps the foot constantly in proper position and prevents any deviation of the leg.

In some instances Steinmann's nails may be used for extension. I must confess to a prejudice against this method. I prefer plating the fragments when any operation is necessary.

While the little operation of thrusting an aseptic nail through the extremity, including the bone, may itself be attended by little danger, it is quite a different matter during the weeks of traction on this nail, for the soft tissues must be irritated by the pull and movements, produced by the varying position of the patient, and infection is very apt to follow the irritation.

After any method of reduction and dressing, especially after a fixed dressing, such as plaster-of-Paris, has been put on, a skiagram should be taken or a fluoroscopic examination be made to find out clearly whether the fragments are held in good apposition. Overlapping to a slight extent in cases of oblique and spiral fractures will not very much hinder good union and satisfactory function afterwards, provided there is no angulation or rotation of the fragments on the proper axis of the bone.

Overlapping in cases of transverse, or short, irregularly oblique fractures, will make a great difference, however; much deformity, doubtful union, and usually long delayed and never complete function will result. When I find serious overlapping after attempting to reduce and fix a fracture, I make another attempt, and if again unsuccessful in restoring the fragments to proper position, my rule is to operate.

Whatever apparatus is used, in about three weeks at least the limb should be carefully inspected, carefully washed off with alcohol and massaged. The ankle-joint should be thoroughly moved and the knee-joint should also be flexed as much as practicable without provoking spasm of the muscles and displacement of the fragments.

In many instances a surgeon waits too long before he begins massage and passive movements. I would not go so far as Championniere in regard to massage in fractures, but it seems to me it should be employed as early as practicable.

*Fractures of the Lower Third of the Femur.*—The diagnosis of these fractures is usually easy. The displacement of the ends of the fragments follows the general rule of fractures of the femur below the upper third. The distal fragment is usually drawn upwards as regards the proximal fragment (except in cases of the specific fracture to be

mentioned presently) ; unless they are badly lacerated, the abductors are very apt to draw the proximal fragment inward ; in which case the distal fragment will be found displaced upwards, a little backwards and to the outside.

There is a fracture, however, usually transverse, the displacement of which is, distal fragment backwards and tilted so that the end presses backwards into the upper part of the popliteal space. This fracture is produced by the whirling motion caused by a rotating wheel. Children who jump on wagons and whose lower extremity is caught in the wheel, and workmen caught in slowly revolving large machine wheels, have this special kind of fracture.

The condition is a very characteristic one. It is an extremely painful one, because the end of the lower fragments presses firmly against the blood-vessels and nerves which pass through the popliteal space. Also grave injury to the vessels may result from this pressure. It is, therefore, necessary to reduce this fracture very soon to prevent thrombosis in, or laceration of, the vessels. If it is not practicable to reduce the fracture at once, the leg should be flexed at the knee and immobilized in this position until an anæsthetic may be given and reduction accomplished.

One must have in mind that this fracture is the analogue of fracture of the lower third of the humerus, just above the condyles. Jones, of Liverpool, has taught us that to reduce and to hold the fragments of the humerus in place it is necessary to acutely flex the forearm on the arm and fix it in this position. A similar method of reduction should be used in the supracondyloid femoral fracture, namely, extreme flexion of the knee-joint and manipulation of the distal fragment into place. Ordinarily this may be accomplished, and when reduced, as it is a transverse fracture, one has only to jam the fragments end to end and have them held in this position while the leg is slowly and carefully brought to its proper position. A fixed dressing of plaster-of-Paris may then be applied.

When the violence has been great, however, the displaced lower fragment may be caught between the heads of the gastrocnemius and the hamstring tendons, and lacerated shreds from the fibrous structures may be so wrapped about the ragged ends of the fragments that they will firmly be held, and no manipulation or position will suffice to release them. In this case an open operation will be necessary in order to obtain good restitution of the fragments. Jones, of Liverpool, however, says a Thomas extension splint will accomplish the restitution.<sup>4, 5, 6</sup>

Ordinary fracture of the lower third may be treated by traction

## FRACTURES OF THE FEMUR

methods, with Hamilton's coaptation splints to prevent deviation. For children, and for some not very strong and thin adults, a fixed dressing of moulded splints, preferably plaster-of-Paris, applied in general anaesthesia, may be used to advantage. When the plaster has hardened, the extremity may be swung clear of the bed by attaching bandage supports and cords carried to a bar above the bed. When the reduction has been good, the method of treatment is a very grateful one. Skiagrams should be taken soon after the dressing is applied in order to be sure of the reduction.

*Results of Fracture of the Femur.*—Up to this time there has not been established any authoritative standard by which surgeons might compare their results after fracture of the femur.

In 1890 the American Surgical Association appointed a commission to determine and report what should be the conditions which should be considered as indicating good end-results after fractures of the femur.

The summary of the report of this commission is as follows:

1. There must be firm bony union.
2. There must be correct axial relations of the fragments.
3. Correct relations of the anterior planes of the upper and lower fragments must be maintained.
4. Shortening must not exceed from one-eighth to one inch.
5. Lameness must not occur as a result of shortening over one inch.
6. The conditions attending the treatment, however, may prevent these satisfactory results.

This is a standardization from an authoritative source, certainly, but it was made before the era of X-ray, and the surgeons of that time did not practise open method for the treatment of fractures.

A committee of the British Medical Association made a report on the results of fractures in Great Britain in 1912, but did not attempt standardization, either of results or disability.

The American Surgical Association has a committee working on this matter of standardization. It is to be hoped that this committee will be able in another year to formulate a standardization which will bring the condition up to date.

Last year this committee made a preliminary report and in regard to fractures of the shaft of the femur its conclusions were as follows: "Fracture of the shaft of the femur should not result in shortening greater than 2 cm., nor in a fixed position of angulation or rotation which will affect the joints and require new habits of balancing or tilting of the pelvis; joint function should be good. No permanent disability of the affected member should result."



Taking the above standardization as existing at present, what is the average result obtained by surgeons who treat fractures of the femur?

In 1912 I made a study of 760 cases of fractures of the femur, collected from many surgeons. Unfortunately, the records of these cases were so incomplete, in most instances, that it was impossible to deduce accurate data from them. Seven hundred of these cases were reported to have made satisfactory recoveries. I presume this may mean that 700 out of 760 cases had bony union.<sup>3</sup>

The Committee of the British Medical Association analyzed 726 fractures of the shaft of the femur and noted 60 per cent. good results.<sup>2</sup> The Committee of the American Surgical Association last year studied 364 non-operative cases, and reported 67 per cent. good anatomical and functional results.<sup>1</sup>

In regard to correct axial relation of the fragments, 620 of my cases had this point noted, 114 of these cases (or 18.1 per cent.) had serious axial displacements.<sup>2</sup>

The average shortening of the reported cases did not exceed 2 cm.

This matter of shortening, however, is a very uncertain one. It is well established that a man's femora are rarely the same length. Sometimes they vary, in what seems normal conditions, as much as 2 cm.<sup>5</sup> I had, not very long ago, a thirteen-year-old girl under treatment, one of whose femora was nearly 3 cm. longer than the other. This was a case of unequal development apparently, however, with the same conditions of the legs on both sides, and like conditions of development, etc.

Then, too, measurements are frequently very carelessly and inaccurately taken and may not be trusted. Therefore, unless lameness results as a consequence of the shortening, or serious tilting of the pelvis and spinal curvature develop as a consequence, I think not more than 3 cm. shortening may result in a good functional result. If there is this much shortening, however, as a result of the fracture, it is surely due to overlapping of the fragments. This will require a large callus to assure firm union, and this, in turn, will produce some deformity and usually cause a good deal of pain for some time.

One must bear in mind now that the almost universal use of X-ray, and the demand of a patient to have a print of the plate, require of the surgeon not only good functional result but good mechanical and good cosmetic results also.

In the report of the 760 cases of fracture of the femur, which I studied, only 130 were reported as skiagraphed; 83 of these, or 63 per cent., showed good apposition.<sup>3</sup> These X-ray cases came from the

## FRACTURES OF THE FEMUR

best and most systematic surgeons, and cannot be considered the average result obtained by all surgeons by any means. Also, if I may judge by my own experience, this does not express the result of the old conservative treatment, but it is the average result of both methods, viz., conservative and open methods.

Of 299 of my own cases of fracture of the shaft of the femur, 100 of which were compound, comminuted or complicated fractures, the average shortening when they left the hospital was  $1\frac{1}{2}$  cm.

All but one of these cases had firm bony union. Only about 2 per cent. of those treated by the conservative method showed accurate reposition of the fragments, when skiagraphed after the permanent dressings were applied.

In one case of compound comminuted fracture, when the fragments were cleared away, I found there was a loss of five centimetres of the shaft, yet this patient made a good functional recovery, and by the use of a high shoe was able to work again.

Axial displacement is a very serious matter in a final result. This not only is apt to lead to distortion of the pelvis and spinal column, but results in persistent pain in the ankle- and knee-joints, and it usually incapacitates a man for further laborious work.

The cases I have been able to trace and follow up have only been about 30 per cent. of my fractures; these have been able to return to their former jobs. These cases had no serious axial displacements. When, some time ago, I found, by the old method of extension, external splints, etc., as I said, only about 2 per cent. of my cases showed accurate apposition, and in many instances cases which seemed in perfect alignment, and showed very little shortening by the usual methods of measuring, when skiagraphed, exhibited overlapping and poor apposition, I became so disgusted that I began seriously to consider, and to practise far more generally, the operative method and direct splinting of the bone.

Of the last 65 fractures of the femur we have treated at St. Luke's Hospital, I find 25 of them were plated, 38.46 per cent., whereas five years ago only 7 per cent. were plated. So far we have had no fatality from these operations, and but one case has been seriously infected out of 25 cases operated. This case passed through the operation and operative convalescence without any infection, but was infected when the pegs were removed. It was a streptococcal infection. He made a good recovery and the union was not disturbed.

What are the advantages of the open method, and when or in which cases ought it to be used?

It will be better to take the last question first. In my clinic at St. Luke's Hospital it is the rule in simple fractures of the femur to attempt reduction in general anæsthesia and while the patient is relaxed and unconscious to apply a permanent dressing. Then the fracture is skiagraphed. If the reposition is not good, especially if the fragments are not in alignment, another effort at reduction is made and again a skiagram is taken. If again the position is bad, the state of affairs is explained to the patient and he is offered the operation. We find patients very rarely refuse to have the operation. Within ten days after the fracture the operation is performed.

To treat the question dogmatically, I would say, fractures of the neck within the capsule should always be treated conservatively.\* The open method may be used on such cases only when the head has been dislocated from the acetabulum.

Fractures of the upper third offer especial and cogent indications for the open method.

Fractures of the middle third may best be treated by the open method if they are transverse, and cannot be reduced by general anæsthesia, traction and manipulation. Oblique fractures which have short, irregular bevels or shoulders, and those which have markedly been displaced and have gathered on the ends and between the fragments a quantity of fascia, muscles, etc., are indications for the open method.

A fracture of the lower third, if it be one which has the lower fragment tilted backward in such a way that it has been entangled in the lacerated fibres and fascia of the heads of the gastrocnemius muscle and hamstring tendons and cannot be replaced under ether by manipulation and flexion, should, as a rule, be treated by the open method.

In general, a fracture of any part of the femur, except its neck, which cannot be reduced in anæsthesia, and retained in position by some proper apparatus by the middle of the second week, should have the benefit of an open operation, unless there is a contra-indication in the condition of the patient or there exists some strong social or medico-legal consideration against it.

In determining the question of open or closed method, the surgeon should never forget that a finite operator doing an open operation on a human being can never be sure he is not introducing some sort of sepsis. There is, therefore, always a possible added danger in open operations.

Furthermore, open operations for fractures of the femur require large wounds and are not easy operations to perform. They may prove

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\* I am aware of J. B. Murphy's opinion to the contrary.

## FRACTURES OF THE FEMUR

a serious tax on the strength of a patient and must never be lightly undertaken.

The surgeon should not forget all this and he should make the patient appreciate the main factors of the probable result without the operation, and its added danger if undertaken.

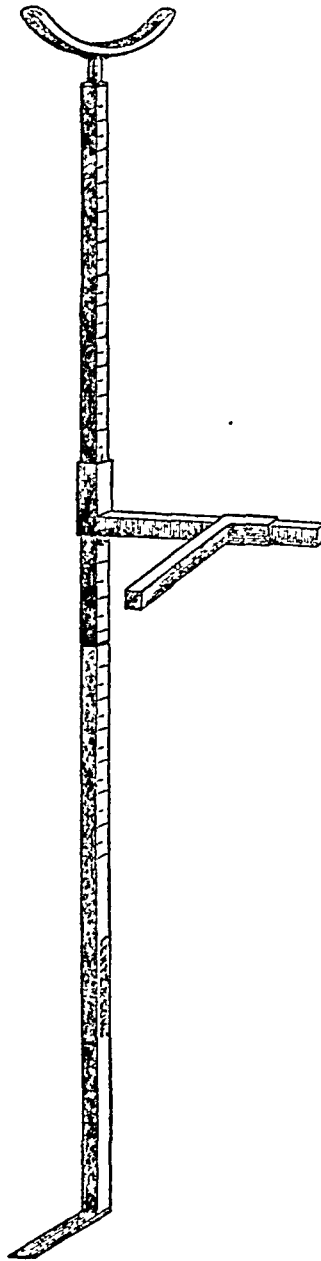


FIG. 1.—Measuring rod used for accurate determination of shortening or angulation after fractures or in deformities of the limbs.

The advantages of the operation are (1) direct ocular examination of the condition of the fragments; (2) reposition and fixation by direct splinting of the bone while under one's eyes; (3) evacuation of the blood and detritus from about the fragments; (4) a condition

almost painless during after-treatment and convalescence; (5) much more freedom of movement in bed while convalescing; (6) earlier employment of passive movements and massage.

As regards results, our experience has been that the operated cases require a little longer period of hospital disability, probably three weeks longer. The alignment is always good and very rarely does any bowing occur afterwards, unless the patient is allowed to bear weight too early. In every instance, so far as we have been able to follow our cases, the patient has been able to return to his former job, except in one case, who fractured his bone while still in the hospital. He has considerable overlapping and callus and shortening as the result of his last fracture, which was treated without operation.

The average period of disability for fracture of the femur worked out in our cases is thirteen months. This means the time a laborer may count as necessary before he may with confidence return to his hard work. Most cases leave the hospital in ten weeks, walking with the aid of a cane or crutches, but it requires a much longer period for them to be able to do a full day's work. Our follow-up system shows, as said above, the average time for full ability is thirteen months.

NOTE.—The author demonstrated a new measuring rod which in his opinion enables one to overcome many of the difficulties and inaccuracies of measuring fractures (see Fig. 1).

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FIG. 1.—Jig-saw osteotomy for deformity of knee following a resection for tuberculosis (thirteen years). Lateral view (November 13, 1914).

# TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

*Stated Meeting, held November 10, 1915*

The President, DR. CHAS. N. DOWD, in the Chair

## JIG-SAW OSTEOTOMY FOR DEFORMITY OF KNEE

DR. H. H. M. LYLE presented a youth, aged twenty-one years, who had had a resection of the knee for tuberculosis performed thirteen years ago. Shortly after this operation a marked flexion deformity appeared. The knee was firmly ankylosed at  $135^{\circ}$ , there was  $4\frac{1}{2}$  inches shortening, and the patient was unable to walk without the aid of crutches. X-ray plates and photographs were shown to demonstrate the condition before and after the operation.

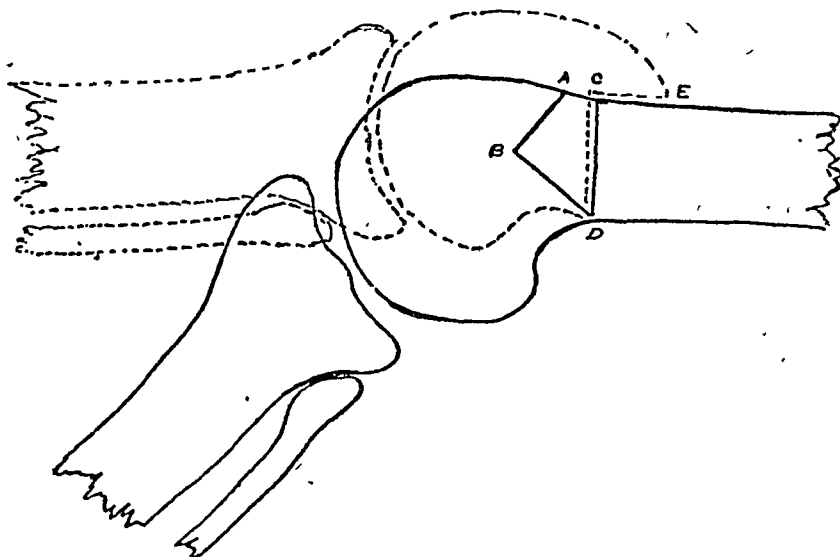


FIG. 2.—Osgood's osteotomy.

Considering the past history, and knowing the difficulties of maintaining a correct alignment after the ordinary osteotomy, Dr. Lyle decided to perform Osgood's operation (*The End-Results of Attempts to Mobilize Stiffened Joints, Surg. and Obst., 1913, xvii, p. 664*). Operation, St. Luke's Hospital, December 11, 1914 (Figs. 1 and 2). Under gas and oxygen two lateral incisions just above the condyles were made. These two incisions were then joined by tunnelling between



## NEW YORK SURGICAL SOCIETY

the anterior surface of the femur and the posterior surface of upper cul-de-sac of the joints. A blade of a carpenter's copying saw was inserted, adjusted to the handle, and the cut *C.D.* at right angles to the femur was made. The cut *C.D.* does not go completely through the bone. The blade was detached and left *in situ* as a guide. A second blade was then inserted at *A.* and the cut *A.B.D.* made, thus freeing the quadrilateral section of bone *A.B.D.C.*, which was pushed out through the wound. Extension was then made, producing a green-stick fracture at the point *D.* The surface *D.B.* was forced against *C.D.* and the surface *A.B.* against the surface *C.E.* The projection *C.E.* prevents the possibility of a posterior dislocation. The knee was then immobilized in plaster and a firm bony union was obtained in six weeks. The great merit of the operation is its simplicity.

DR. LILIENTHAL referred to the condition found in a boy, twelve years of age, who had been under his care. There had been a fracture of the lower end of the femur, with such great distortion and such complete retroposition of the condyles that the boy had a shortening of about four or four and a half inches at least. Dr. Lilienthal did an operation, similar to the one described by Dr. Lyle, and got a very perfect and beautiful result. The boy not only walks nicely, but he has good motion of the knee-joint of more than a right angle. Of course he didn't have any disease in the joint. The operation was most satisfactory. It is well thought out and it is simple of execution.

### PAPER CLIP IN BRONCHUS FOR SEVENTEEN YEARS REMOVED BY SUPERIOR BRONCHOSCOPY

DR. EDWIN BEER presented a man, twenty-six years old, who gave the following history: Seventeen years ago, while playing with a paper-clip, it suddenly became lodged far back in his throat. His parent attempted to extract it with a spoon, but pushed it further down. Next day the patient was seized with paroxysms of coughing and raised a lot of mucus and blood. He had great difficulty in breathing. These symptoms gradually disappeared, only to become ill soon again with what was diagnosed as pneumonia. He was then in bed for about six weeks, but finally recovered, and remained well for about two years. From that time on he began to have pain in his right side and a hacking cough with copious expectoration. He was told that he had tuberculosis. Subsequently he was told that he had asthma. For these conditions he was treated for over twelve years, in numerous institutions, and by many physicians. Gradually his sputum became copious and more foul, and his general health began to suffer, so that he could not

## PAPER CLIP IN BRONCHUS

work. He applied for admission to Bellevue Hospital, thinking he was a hopeless case of pulmonary tuberculosis, and on questioning immediately told of the accident with the paper-clip seventeen years ago. An X-ray of his chest, which shows the clip very clearly, confirmed the patient's history, and on July 15, 1915, under general and local anæsthesia, by the superior route, the clip was readily discovered in the lower right bronchus, and extracted with the bronchoscope. The patient made an uneventful recovery, and left the hospital four days later, relieved of his pain, and coughing and expectorating less.

A recent X-ray shows that the thickening in his lung is less marked, though considerable is still present. He still has some cough and some expectoration, undoubtedly due to the bronchiectasis induced by the presence of the clip in his lung for so many years.

**NOTE.**—The only other case in which a foreign body had remained in the lung for such a long period and was then removed by bronchoscopy, is that of C. Jackson, who removed a collar-button twenty-six years after aspiration.

DR. WILLY MEYER described the case of a young man in the early thirties, who had had typhoid fever years ago, and shortly afterwards began to suffer from difficult breathing; then he was better for a while, and lately he could not sit up without coughing. The greater part of the day he had to lie on his back. Bronchoscopy was done by Dr. Yankauer, who saw a foreign body in the bronchus. He extracted a piece of bone which on examination proved to be the necrotic cricoid cartilage.

The history showed that the man had had typhoid, had been extremely sick, delirious, unconscious, and evidently during that time he had developed a perichondritis, and the necrotic cricoid cartilage slipped into his bronchus. He had carried it there for fully twelve years. After extraction he was perfectly well.

DR. LILIENTHAL emphasized the advantages and the indispensability of bronchoscopy in all cases in which an atypical suppurative cough exists.

Only a few weeks ago he was called to see a young boy, about five years old, who had developed a peculiar hard, rasping cough which had continued for a number of days, and then developed flatness of the left chest, so that his physician thought he had an empyema. His temperature was running about  $104\frac{1}{2}^{\circ}$ , then he came down to normal for three days, and then had another exacerbation of temperature, and always with this sharp, ringing cough, which is quite characteristic.

An X-ray was made at the Mt. Sinai Hospital without definite result.

Dr. Yankauer then introduced a bronchoscope and found a water-melon seed in the child's trachea, which was easily extracted and a very prompt recovery made.

#### CARCINOMA OF THE NECK OF THE BLADDER AND PROSTATE

DR. EDWIN BEER presented a man fifty-eight years old, who since September, 1914, had suffered from increased frequency of urination accompanied by pain. He had one attack of hæmaturia.

January 26, 1915, cystoscopy showed bullous œdema around posterior circumference of neck of bladder, with extensive tumor formation on posterior wall and trigone.

Rectal examination showed a slightly enlarged prostate, and in median line just below junction of prostate and bladder a small, stony, hard mass. Another nodule somewhat larger was felt in the position of the right seminal vesicle.

January 27, 1915, he was subjected to a combined abdomino-perineal excision of bladder, perivesical connective tissue, seminal vesicles, lower ends of ureters, and prostate.

The patient made a satisfactory recovery, and is now presented almost ten months after operation, in excellent condition, without any signs of recurrence, and in spite of wearing permanent indwelling ureter tubes, he is free from any severe renal infection, and in comfort.

The pathological report was papillary carcinoma.

#### BENIGN STRICTURE OF ŒSOPHAGUS (ŒSOPHAGOSPASM'): TRANSTHORACIC EXPLORATION OF ŒSOPHAGUS

DR. HOWARD LILIENTHAL presented a man fifty-four years old, who for a year had been growing weaker and had lost weight coincidentally with gradually increasing difficulty in swallowing.

When first seen by Dr. Lilienthal, on October 8, 1914, even fluid was swallowed with difficulty. An X-ray by Dr. Jaches had demonstrated an almost complete stricture at the level of the third dorsal vertebra. The patient was emaciated but his general condition was still not bad.

On October 15, 1914, in the Private Pavilion of Mt. Sinai Hospital, he performed gastrostomy by Hall's method, in local anæsthesia. On opening the abdomen between the fibres of the left rectus an extremely mobile stomach was encountered, the pylorus being with ease drawn out of the incision. A cone of stomach near the greater curvature was pulled up from the wound and sutured at its base, all around to the peritoneum and posterior rectus. An opening was now made at the

## BENIGN STRICTURE OF ŒSOPHAGUS

apex of this cone into which a small catheter was sutured with catgut, and the cone with the catheter was inverted into the lumen of the stomach, the inverted cone being packed with gauze. A test as to the patency of the tube was made with water and a funnel. Two weeks later first dressing. Patient gradually gaining in weight. He was nourished by way of the fistula every two hours and rapidly gained; left the hospital on November 6, about three weeks after his gastrostomy.

Aware of the possibility that an inoperable carcinoma might be present, he had in mind the expedient of operating so as to connect the dilated œsophageal pouch with the gastric stoma by means of a rubber tube outside of the body, so as to enable him to swallow and so as to drain the œsophagus.

The patient gained in weight and early in December Dr. Jaches attempted to make a sausage-skin radiograph of the stricture so as to outline its limit. The sausage skin was drawn through from the œsophagus into the stomach by means of a silk thread previously swallowed and fished out of the gastrostomy opening. The sausage skin leaked, however, probably owing to the rapid digestion by the stomach juices. Later on a stronger string made of hog's gut was used, with the result that it was possible to obtain a satisfactory picture.

With the understanding of the patient and his friends that the operation might prove hazardous, but that amelioration would be in all probability impossible without it, he operated on December 10, 1914. With the aid of intratracheal anæsthesia by Dr. Branower and with the assistance of Dr. Martin W. Ware, he performed an exploratory thoracotomy and posterior mediastinotomy. The patient received one-third of a grain of morphine about an hour before the operation. The œsophageal pouch above the stricture was washed out. The seventh, sixth, fifth and fourth ribs were divided just beyond their articulation with the spine. The lower part of this incision was carried through the seventh interspace through the entire distance to the costal cartilage. Pleura at once opened and rib spreader put in. Exposure was excellent but the work was done very slowly. The left lung was found adherent at the apex, but the adhesions were cord-like in character and were easily divided between ligatures. The pleura over the mediastinum was now incised, and with the help of a stomach-tube in the œsophagus the gullet was easily recognized. Work here, however, had to be done very slowly, because he feared vagus manipulation with cardiac paralysis. One intercostal artery as it came from the aorta, probably the fourth, was divided between ligatures. No tumor was found, but the stricture was located without difficulty, using a good-sized stomach-

## NEW YORK SURGICAL SOCIETY

tube as a guide. The muscular coat of the œsophagus was comparatively little constricted, the conclusion then being reached that most of the trouble was in the mucous lining. From the fact that the man had been ill for more than a year, they concluded that no malignant tumor existed. An attempt was now made to put in a fine urethral instrument under the guidance of the eye and with the aid of the fingers in the thorax, but this was impossible. The prognosis, however, being good in the absence of cancer, provided the patient should recover from this large operation, nothing more was now done. The large incision was closed with catgut through the muscles and silk through the skin. A few chromic catgut sutures were placed in the intercostal incision by the pericostal method. Entire wound closed without drainage, the lung being fully distended at the time of the completion of the suture.

On examining the history chart after the operation it was found that this patient had had 103 degrees of fever the night before the operation, which fact the house officers had not told the surgeon.

At the end of the operation, which had taken two hours, there appeared to be a considerable shock, but a sharp reaction to 104 degrees was followed by a drop to the neighborhood of 100 degrees. Next day the patient was in excellent condition.

Three days after the operation the patient was sitting up out of bed. At the first dressing on the sixth day the wound was found healed by primary union. The temperature remained under 101 degrees, pulse of good quality and rarely faster than 112.

The string was now again swallowed and gradual dilatation practised with tubes of various sizes, drawn from the mouth to the stomach, until the largest size stomach-tube could be passed with the greatest ease.

On January 1, 1915, the patient was discharged from the hospital, still wearing the string. The dilatation was kept up about twice a week. He could swallow solid food perfectly, and except for the presence of the string, which annoyed him, he was comfortable. Some weeks later he began dilating with the Plummer instrument, and finally, at the urgent insistence of the patient, the string was removed. The patient was advised not to let the gastrostomy wound close, but he felt so well that he neglected the precaution of keeping it open, and it promptly healed. For a time Dr. Lilienthal was able to dilate with the Plummer instrument almost to its full size, but it became very difficult to avoid the pouch in the œsophagus. Some days the instrument passed without the slightest difficulty; at other times it was quite impossible to insert it. The man now eats food of all kinds and has no difficulty in swallowing. Still there are signs of stasis in the pouch and he now

## BULLET WOUND OF KNEE

washes it out every day to prevent decomposing food from settling therein. If signs of stricture recur it will probably be necessary to make another gastrostomy and dilate. Perhaps had there been a string in the stomach at the time of operation something could have been done to straighten out the kink, but this is problematical. The final diagnosis is spastic stricture of the œsophagus. The case is here presented as an example of Torek's thoracotomy and Dr. Lilienthal can testify to the comparative simplicity and to the adequacy of exposure which this method affords. He had since used it in another case, in which extirpation of a cancer of the thoracic œsophagus was performed, the patient dying two days later of acute infection. This case will be reported in full elsewhere.

It is interesting to note, however, that in this second case the entire operation was performed with intrapharyngeal anæsthesia instead of intratracheal. There were some veil-like adhesions in the chest which may have added to the safety of this form of anæsthesia by keeping the mediastinum partly supported, but in other cases the intrapharyngeal method has been so satisfactory that I have adopted it as a routine. It is perfectly possible to collapse or expand the lungs by this method and there is also the great advantage that the lung on the side which is being operated upon can be collapsed without interfering with the expansion of the opposite lung. This is an enormous advantage of the intrapharyngeal method of differential pressure.

DR. WILLY MEYER said that all the cases of thoracotomy which had been done at the German Hospital without opening the œsophagus were successful. Even where they worked for some time in the thorax, as long as they did not try to open the œsophagus, every one was a success. In other words, exploratory thoracotomy without opening the œsophagus is a safe operation, but as soon as one interferes with the lumen of the œsophagus, then trouble comes in. In all such cases drainage should be used.

## BULLET WOUND OF KNEE

DR. KARL CONNELL presented a boy, fifteen years old, who had been shot in the knee three months previously. The bullet was from a .38-calibre revolver at a distance of three yards, penetrating the left knee-joint. The missile entered lateral to, and above, the patella, traversed the outer condyle of the femur upward and backward, and lodged in the lower fourth of the shaft of the femur.

On admission to the Roosevelt Hospital, service of Dr. Charles H. Peck, two hours after the injury, the boy's knee-joint was distended

## NEW YORK SURGICAL SOCIETY

with blood and exudate. Dr. Connell opened the joint twenty-four hours after injury by five vertical incisions, exposing freely the superior, the two lateral and the two posterior main pouches of the joint. These pouches were irrigated with weak iodine solution. The wounds were then closed without drainage by loose suture of the skin.

The bullet itself was removed by separate incision, lifting the popliteal structures from the femur and chiselling a block from the shaft of the bone. The bullet was deformed and presented fibres of woollen cloth on its nose. This latter wound was packed wide open.

There was moderate constitutional reaction, but the temperature remained normal after the fifth day. On the sixth and eighth day several of the wounds into the knee were probed open by phenol swab, to release a small pocket of turbid synovial fluid collecting in the subcutaneous tissue. On the tenth day all the wounds into the joint had healed. The incision to the bed of the bullet, however, developed a putrefactive infection, such as is commonly seen with the low velocity débris-laden shrapnel bullets of Europe. However, this infection remained local and the joint itself remained uninfected. This wound healed in about eight weeks without discharge of any bony sequestrum.

Joint movement is now painless, the boy walks without limp, the traumatic synovitis has gradually subsided, and the knee flexes past the right angle.

Dr. Connell stated that the case was presented to exemplify a distressing type of injury commonly observed in his experience through the past winter in the war zone of France and the Central Empires. The case further exemplifies the wisdom of early and radical surgical cleansing of the knee-joint in wounds inflicted by low velocity débris-laden missiles.

### KNEE-JOINT PERFORATED BY RUSTY NAIL

DR. CONNELL presented a second case of knee-joint injury, a medical student twenty-one years old. Fifteen years previously he had fallen on a rusty nail, which penetrated to the outer side and below the patella. That night the knee ached and became stiff.

On admission to the service of Dr. W. T. Bull at the New York Hospital the next day, the knee-joint was distended, tender, and of increased heat. Two days after injury the joint was aspirated by Dr. W. C. Clarke, and injected with 1 per cent. aqueous phenol solution. Two days later it was again aspirated and injected. The first aspiration showed the staphylococcus albus in culture.

On the seventh day the inflammation had markedly subsided and

## KNEE-JOINT PERFORATED BY RUSTY NAIL

the knee continued to improve without further surgical interference. The knee-joint of this patient presents to-day no limitation of function. It exemplifies a type of mild infection yielding to minor surgical interference.

DR. CONNELL presented a third case of knee-joint injury, a woman forty-eight years of age. Eight months ago, while in a dentist chair, the patient was struck by a dental probe, which imbedded itself in the thigh, two inches above the patella. The probe was easily withdrawn. Eight days later the wound became reddened and the knee-joint gradually became sore and stiff. Two weeks after the injury the patient entered the Roosevelt Hospital; the knee-joint was moderately painful and was held rigidly; it was slightly tender and moderately distended. The wound above the patella was suppurating and was opened into the subcutaneous tissue. The joint was aspirated of turbid fluid which showed on culture the staphylococcus aureus in one of two culture flasks. It was supposed that one flask might have been contaminated. The joint was immobilized without further surgical interference. One month later the condition had not improved, the patient had lost weight, and had become slightly septic. The joint was therefore aspirated of turbid fluid, which showed many staphylococci. It was injected with Lugol's solution of iodine. Moderate constitutional and local reaction followed and the joint fluid became more frankly purulent. Further aspiration and injection failed to control the process, and two months after the injury the upper and lateral pouches were drained. After several weeks of imperfect drainage, the patient fell into a low delirium. The joint was therefore opened completely by transverse incision across the patella, and dressed wide open in acute flexion.

Suppuration extended beneath the quadriceps extensor muscles and necessitated multiple incisions to the upper third of the thigh. The constitutional sepsis subsided in about six weeks, when the joint was again extended fully by continuous traction. Flexion recurred after several months. Therefore, the joint was resected. It is now ankylosed and healed except for several small sinuses.

The acutely flexed position in this case presented the usual mechanical difficulties of retention, and of again securing extension of the joint, with no commensurate advantage of drainage over the transverse drainage incision with the joint left in full extension.

A fourth case of knee-joint injury was presented: a man who had sustained a small wound by broken glass over the knee-joint several months previously. The wound was sutured the day of injury without drainage. Two weeks later he presented himself at the Roosevelt



## NEW YORK SURGICAL SOCIETY

Hospital with an extensive cellulitis over the knee-joint and suppurating hæmarthrosis of the joint. The joint was widely drained by multiple incisions. The case passed through the usual two months of profound sepsis and four months of slow repair. The leg is now in good position, slightly flexed, and the joint is ankylosed.

DR. A. G. GERSTER said that he had seen perhaps fifteen or eighteen cases of traumatic infection of the knee-joint.

There was one traumatism which was most interesting, caused by an old-fashioned surgeon who put a seton through one of the periarticular bursæ on the inner side of the knee-joint, which ordinarily communicate with the joint. In drawing that seton through this bursa every day, or every other day, an infection of the bursa occurred which affected the knee-joint. This happened in a woman who was suffering from diabetes, and you know how the case ended.

Now, then, in going back to the presentation of the subject from the pathological aspect, the doctor had correctly classified the subject into, first, those cases in which a mild infection involves the inner line of the joint; that is, the synovial membrane. Then he went on to the cases that are more severe, where there is a sepsis that is not local, but also affects the general condition of the patient; and, finally, he came to the so-called gangrene cases, which, as the doctor states, are very rare in civil practice but very common in war practice.

There is one more class which the doctor hasn't mentioned, and the existence of which was demonstrated frequently after we adopted Mayo's method of treating these knee-joints. In adopting the Mayo treatment in very severe cases, it was found that there is a form of infection which does not affect alone the synovial lining but also infects the layer of connective tissue, which is situated between the synovial membrane and the capsule, a layer which is not uniform everywhere, which is very thin in some localities and rather massive in others, and in this layer a phlegmon will develop such as will develop in phlegmons on the palm of the hand.

It is plain that irrigation of such a joint will give no benefit whatever, and the patient will succumb to long suppuration and the detachment and extrusion of the necrosed material. In these cases, undoubtedly the free exposure of the joint is the proper thing to do.

DR. H. H. M. LYLE said that during the Spanish-American War in Cuba there were seventeen gunshot wounds of the knee. In Juilly, France, they had fifty joint cases (exclusive of joints of foot and hand); twenty-three of these were wounds of the knee, with one death and two amputations. The wounds of the knee fall into three distinct classes:

## KNEE-JOINT PERFORATED BY RUSTY NAIL .

1. Wounds of the knee-joint without damage to the bone.
2. Wounds of neighboring structure with fractures leading to the bone.
3. Wounds of the joint with damage to the articular bones.

Dr. Lyle said that prompt operative interference was imperative in all penetrating wounds of the knee-joint which showed the presence of a foreign body. There are no exceptions to this rule. Prompt operative interference is also necessary in all perforating wounds of the knee-joint caused by shrapnel and shell fragments, even if the missiles have not lodged. Shrapnel and shell carry foreign bodies into the joint, consequently all such wounds are to be regarded as potentially infected; on the other hand, perforating bullet wounds often remain aseptic, and can be treated conservatively.

The type of operative interference should depend on the condition. For the early and simple case bilateral arthrotomy, disinfection of joint, removal of the foreign bodies, with the application of an embalming dressing. If the foreign bodies could not be removed from the joint by bilateral arthrotomy, or if this procedure was insufficient, or if the patella was already fractured, a transverse arthrotomy by cutting across the patella tendon was performed. Next in order came a resection. Tuffier is an advocate of resection to save amputation. The indications for an immediate amputation are extremely rare. Indications for a late amputation should be uncommon and only occur in neglected cases.

As to the details of treatment, infinite care and patience were required to obtain good results. Immobilization combined with traction gave relief and made the dressings much more comfortable. Types of splints used were the Blake, Mauclaire's fenestrated plaster, and the Steinman pin in combination with the Juilly splint. Drainage was established by large well-placed incisions and rubber dam; no rubber tubes were used.

The importance of the after-treatment of these cases could not be overestimated and massage and movements should be directed by the surgeon himself. If an ankylosis was expected, the knee was placed in a slight degree of flexion; hyperextension should be avoided; on the other hand, if motion was expected, the knee was placed in a position of hyperextension, because it was found that walking on a partly flexed joint was painful and set up articular trouble.

DR. CONNELL, in closing, stated with reference to the treatment of septic arthritis of the knee-joint, that his experience in the European war zone was all against early resection. He had observed several cases, which after early resection developed a violent osteomyelitis of the femur. One of these cases died and another came to amputation at

## NEW YORK SURGICAL SOCIETY

the knee-joint. These joints had been resected before the infection had entirely cooled down, and the bone had reacted deeply into its interior, as it does after some months of joint suppuration. Thus, by resection, free portal had been given to extension of infection. Other cases of early resection were cited which had not terminated so disastrously, yet in which the pouches supplicated as persistently and the process as a whole took as long to heal as in those cases where no resection had been done. Therefore, resection should be reserved to a late date, at least several months after the original infection. Resection might then serve some definite mechanical purpose, such as correcting position, or inducing ankylosis; it should not be performed for the purpose of securing drainage.

*Stated Meeting, held November 24, 1915*

The President, DR. CHAS. N. DOWD, in the Chair

### THROMBO-ANGIITIS OBLITERANS

DR. FREDERICK T. VAN BEUREN presented a man, thirty years of age, who had been admitted to Roosevelt Hospital to the service of Dr. Hotchkiss on July 7, 1914. Sometime during the preceding winter he thought that he had frozen his left great toe. He paid but little attention to it at the time. Three months before his admission he noticed a little crack on this same toe, which he picked open with his finger nail. Since that time he had had considerable pain in the toe and the small crack had become a large ulcer (Fig. 1). The pain had been continuous, worse at night, often keeping him awake, and was aggravated by raising the leg to a horizontal position and alleviated by hanging it down. When he lay down and straightened out his legs he felt a throbbing behind his knees. For the previous three months he had had to sleep with his left leg over the edge of the bed. He had had to quit work because he could not stand for long without pain, and he could not walk more than a block or two without severe pain in the calf. His general health was good; he had always been well in the past. His appetite was good and his bowels regular. He denied venereal infection; drank a little beer, and never smoked more than ten cigarettes a day. His family history was negative. On physical examination he appeared well nourished and in good general condition, but walked with a limp (using a cane). His face showed an expression of pain and anxiety. The examination of his eyes, ears, throat and chest and abdomen was negative. His teeth were in poor condition and his gums exhibited marked pyorrhœa alveolaris. His superficial inguinal lymph-nodes were readily palpable and his



FIG 1.—Ulcer of toe from thrombo-angiitis obliterans.



extremities were otherwise negative, except for the following surgical condition: The left leg was slightly œdematous from the knee downwards. All the toes and the adjacent metatarsal region were a purplish red in color, in marked contrast to the other foot, but not cold and not tender, except for the great toe, which was moderately swollen and extremely tender in the region of a superficial, indolent ulcer  $1\frac{1}{2}$  cm. in diameter, with a sloughy base and a rather calloused margin, which occupied the mesial aspect of the base of the proximal phalanx. Pulsation could not be felt in the posterior tibial, anterior tibial or the dorsalis pedis arteries. His urine was normal; temperature,  $98^{\circ}$ ; pulse, 72; respiration, 20. Wassermann was negative. During the first six days he was kept in bed as much as possible and the leg and foot were baked and massaged for one hour each day. He had so much pain, however, that he begged to be allowed to sit in a chair. He sat up for the first two nights with almost no sleep and got very little the third night from a grain of codeine. His discomfort was so great, and other treatment had proved so unavailing, that it seemed justifiable to try the femoral ligation for impeding the return circulation, as suggested by Hesse and Oppel and as carried out by Lilienthal, who reported four cases at a meeting of the Surgical Society last winter, with marked alleviation of the pain in three. So after explaining to the patient that the procedure was in some sort experimental and that no absolute cure could be promised, but that relief from pain was probable, the operation was decided on. July 14, 1914, under ether anæsthesia, a  $3\frac{1}{2}$ -inch incision was made in the left groin, which gave easy access to the vessels, and the femoral vein was occluded by two No. 3 chromic gut ligatures, 1 inch apart, the lower being just above the entrance of the internal saphenous vein. No immediate disturbance was noted and no untoward symptoms ensued. The sheath of the vessels was united with plain gut and the skin closed with silk. On removing the covering from the leg at the close of the operation, moderate duskiness of the leg was noted below the knee. One and one-half hours later œdema and duskiness of the toes were accentuated. He was put to bed with the foot slightly elevated and external heat applied. That night his pain was severe and he required a hypodermic of morphine. The next day he had moderate pain in the toe and there was a bleb  $1 \times 3$  cm. noted on the dorsum of his foot (possibly due to external heat), but the duskiness of the leg had nearly disappeared and the circulation of the toes, which were still pretty red, returned fairly rapidly when pressed out.

For the next ten days his progress was favorable. He had no further pain; the œdema of the leg and foot almost disappeared, and the toes

were much less red. The tenderness around the ulcer disappeared, but the ulcer did not heal. On the twelfth day after operation he had to have codeine. When he left the hospital on July 30 the swelling of his foot had returned, the ulcer of the toe had slightly lessened in size, and the bleb on the dorsum of his foot had broken, leaving thin epithelium exposed. Wound in groin healed by primary union, but there was some œdema of inner part of thigh in upper third and below this region some tenderness on pressure. Patient said that he felt better than before the operation, but not nearly so well as during the past week.

During the next month he was treated in the out-patient department by baking and massage, and after a couple of weeks noticed a distinct lessening of the pain. This improvement continued for several months, and he again became able to sleep with his leg in a horizontal position; was able to walk more than a quarter of a mile without pain, and his outlook upon life has become more cheerful. As his treatment before and after operation have been the same, it is perhaps fair to believe that some of the improvement has been due to the operation itself.

November 6, 1914. Both ulcers had entirely healed about two weeks before. For the past four weeks his treatment had been baking and dermatol powder on the ulcers and a clean white stocking every morning (without a bandage). The sock is washed and boiled every day.

July 26, 1915. General appearance much better. No œdema of leg. Dilatation of internal saphenous in scar. Color and circulation of foot much better. No blueness. Ulcer is much larger and deeper. Toe tender all around it.

October, 1915. Pain continues and ulcer shows no tendency to heal.

November 22, 1915. Pain continues. Ulcer  $1\frac{1}{4} \times 1\frac{1}{2}$  inches.

DR. ALEXIS MOSCHCOWITZ said that this disease does not occur exclusively in Jews, as is frequently seen in literature, because it has also been described in Japanese and in Turks.

A short while ago a paper was read upon the conservative treatment of these cases before the Surgical Section of the Academy. A large number of different methods of treatment have been described. He had had no success with any of them, and he had tried all of them faithfully.

Although he had made it a rule when he got these cases to hint at an amputation, he fought off amputation as long as possible. When he decided that an amputation was the only thing that can do the patient good, he did not amputate peripherally. The Moschcowitz test is undoubtedly known to all, and it had never failed him wherever he had followed the test; healing at least has always been good, and the patient discharged in the shortest possible space of time.

## FRACTURE OF ANATOMICAL NECK OF HUMERUS

When, however, for reasons which appeared at the time to be good and valid, he had amputated contrary to the Moschcowitz test, he had always had occasion to regret it, because ultimately the case came to a second amputation at a higher level.

DR. SETH W. MILLIKEN said there is a patient at the Lincoln Hospital who has been there now for nearly a year, a colored man who has had his right leg amputated at several levels, finally just below the knee through the tubercle of tibia. The left leg subsequently began to bother him in the same way with ulcers forming on the sole of the foot and then on the front of the ankle, and it was amputated primarily through the tubercle tibia. The first stump did heal and remained healed for several months. The left stump never healed and the ulcer area has gradually increased. His condition varies from extreme pain to moderate discomfort. His Wassermann reaction has been positive but antisyphilitic treatment has no effect on the local condition.

## BRANCHIAL FISTULA

DR. CHAS. N. DOWD showed a patient upon whom he had operated for complete branchial fistula (see vol. lxiii, p. 519).

Dr. Dowd showed another patient who had had complete branchiogenic fistula which had been operated upon by another surgeon nearly four years ago. The sinus wall had been dissected away as far as possible, apparently close to the carotid bifurcation, and the remnant was ligatured. There had been no recurrence for more than three years; an abscess had been formed behind the incision scar. He had opened this abscess recently, but could not find that portion of the fistula which led from the abscess cavity to the pharynx. He was keeping the incision open in the hope that a sinus would form which could be dissected to its pharyngeal opening. Methylene blue solution injected into the abscess opening now showed very faintly in the mouth, but a probe would not follow the same route.

## FRACTURE OF ANATOMICAL NECK OF HUMERUS

DR. FRANK S. MATHEWS presented a man who was in an automobile accident five weeks before he first saw him, fell, striking on his right shoulder. On the same day he was put under an anæsthetic, and it was decided that he had a dislocation of the shoulder. Reduction was supposed to have been made and the arm was put up in a dressing.

At the end of four weeks, when the dressing was removed, it was discovered that it had not been reduced, and another effort was made under an anæsthetic to reduce the dislocation. This was not successful



## NEW YORK SURGICAL SOCIETY

either and he was sent to St. Luke's Hospital. An X-ray picture showed that he had a fracture of the anatomical neck of the bone with dislocation into axilla. The head of the bone was unusually low. The head could be felt through the skin of the axilla, and of course it was easy enough to see that the head of the bone was absent from its normal situation.

The nearness of the head of the bone to the floor of the axilla made it very tempting to approach it in that way, and an incision was made in the axilla, first dissecting out a considerable amount of fat so that the nerves and vessels could be seen. The articular face of the bone was turned toward the vessels. One could see the flattening of the axillary artery. The dissection was then carried upward, following as close as possible to the subcapsular muscle, to get at the bone from behind. After very long and very careful dissection he was able to get the head out.

He had musculospiral paralysis and more or less weakness in the distribution of some of the other nerves. The musculospiral paralysis in the four weeks has pretty largely disappeared.

The head of the bone lay in a very dense capsule. The fibrous layer was fully an eighth of an inch in thickness.

### BONE TRANSPLANTATION FOR SARCOMA OF THE HUMERUS

DR. CHAS. A. ELSBERG presented a patient from whom he had removed a sarcoma of the head and upper end of the humerus, and had transplanted a piece of the patient's fibula. The head and about two inches of the shaft of the humerus were removed and the upper five inches of the fibula were removed and implanted into the stump of the humerus. Pathological examination showed that the tumor was a round-cell sarcoma. The patient was an eye specialist and now, after five and one-half months, he had been able to perform various operations, such as extraction of cataract, with that arm. The good result was doubtless due to the fact that the operator was careful to isolate the tendons of the infraspinous and teres minor and to sew them to the periosteum of the upper end of the fibula. X-rays show that the new head has remained in contact with the glenoid cavity. X-rays made one month, two months and four and one-half months after the operation show a gradual deposit of new bone around the transplanted fragment. During the last six weeks the bone deposit has been gradually increased, and during this period he has been gaining more and more power in the limb. At present he can abduct the arm to the horizontal. The head

## ACUTE POST-OPERATIVE DILATATION OF STOMACH

of the fibula has gradually become rounded and the X-ray shows very beautifully a new head more or less rounded like that of the normal humerus.

*Stated Meeting, held March 8, 1916*

The President, DR. CHARLES N. DOWD, in the Chair

## ACUTE POST-OPERATIVE DILATATION OF THE STOMACH

DR. BURTON J. LEE read a paper with the above title, for which see vol. lxiii, page 418.

DR. GEORGE WOOLSEY referred to a case of gall-stones in which the pain had been so very intense that morphine didn't relieve it, so that he had taken a good deal of chloroform for two days before the operation. The operation was not particularly difficult.

Two days later he was enormously distended, and on washing his stomach out, or passing the stomach tube, this was relieved. Treatment by lavage and frequent changes to the prone posture was ordered.

The man recovered, and a striking feature of the case was that when, three or four weeks later, he came down to the city before going off on a trip, he was exceedingly emaciated. He looked like a man who had been through a long typhoid, and it seemed as if there must be some toxic element to account for his extreme emaciation. Dr. Woolsey said that he had treated other similar cases by postural treatment, as well as the stomach tube, and had felt quite convinced that the prone posture had a very beneficial effect.

He thought the explanation of the swallowing of air to be the only one that can be accepted. He could not understand how the production of gas can occur otherwise. He could understand, too, how a dilated stomach will push down the small intestines into the pelvis so as to perhaps cause some pressure upon the duodenum by traction on the root of the mesentery, but this, of course, is secondary. He could not understand how the removal of that pressure on the duodenum is going to relieve the dilated stomach.

The explanation is rather that of regurgitation of gas through the cesophagus.

DR. JOHN A. HARTWELL thought that the acute dilatation of the stomach is a secondary condition, due to some entirely unknown factor. It is not an anæsthetic condition, because it has been reported in many cases where no anæsthetic has been administered. It has occurred quite

## NEW YORK SURGICAL SOCIETY

frequently in the application of plaster jackets for spinal trouble in the child or adult, in the suspended position. It has been reported in one or two cases where a local anæsthetic has been used, and so the general anæsthetic apparently has nothing to do with it. It is not produced experimentally by tying either the pylorus or the duodenum at the jejunal angle. This they had done many times in their intestinal obstruction work and no gastric dilatation ever resulted, except after several days, a chronic condition..

The contents of the stomach is usually gas, as Dr. Lee has pointed out; that is, at first, but it may quite rapidly be followed with the fluid secretion. He had seen four cases within the last two years—all under quite different circumstances; three of them very marked, one fatal, and the fourth one moderate.

The first one was an actual case of operative acute dilatation of the stomach, occurring during operation on the biliary tract, in which the stomach, about half-way through the operation, began to dilate, and so rapidly and extensively that it was impossible to continue with the operation until the stomach tube was passed. Even when the stomach tube was in the stomach, there was not sufficient pressure to expel the gas from the stomach. It had to be taken into the hands and pressed upon, when great quantities of gas would bubble out through the tube and the stomach would be collapsed, but in the course of a few minutes it would fill up again. It did not occur after the operation, and the patient did not suffer.

The second case was that of a child who had received an injury, being struck with an automobile in the lower part of the chest, more particularly on the right side. It was brought into the hospital in a condition of moderate shock, and upon examination the abdomen was seen to be slightly distended, but not markedly so. In half or three-quarters of an hour the abdomen had distended some eight or ten inches in circumference. Under treatment, the air was finally expelled, and within ten hours the child was entirely recovered. But that stomach dilated directly under our eyes at a perfectly enormous rate.

The third case was under the care of Dr. Bulkley, in the Cornell division of Bellevue. A boy who had been run over suffered rupture of the spleen. He was brought into the hospital about five o'clock in the afternoon, and the diagnosis was made. It was noted at the time, less than two hours after his injury, that his abdomen was becoming rapidly distended, particularly in the upper part.

Dr. Bulkley operated on him. On opening the abdomen the stomach was seen to be much dilated, and it dilated so rapidly that it was impos-

## ACUTE POST-OPERATIVE DILATATION OF STOMACH

sible to get it out of the way, and the child died before the operation was completed.

The fourth case was rather unique. It was that of a man fifty-one years old, who had been out of work for eight weeks, and during that time had had scarcely anything to eat, and he was nearly starved. On the day before admission to the hospital he had been given fifty cents, and he had filled himself up with the heaviest, coarsest food he could get, and of course he bolted it down.

In a few moments after that he had intense abdominal pain. He came to the hospital on the following day, presenting the appearance of a man just about to die. Upon examination, it was found that he had an enormously distended abdomen. He had been vomiting enormous quantities of dark brown, bilious material.

A stomach tube was passed and there was a gush of this same kind of material, until four and a half quarts had issued and the entire distention had disappeared. There was nothing else whatever the matter, and in a couple of days he was entirely recovered.

That was a dilatation not quite so acute, though it had come on immediately after he had taken his meal, and had continued progressively during the intervening hours.

In only one of these cases did there seem to be any marked evidence of a toxic condition such as Dr. Lee had mentioned. In that last case the man looked desperately ill and seemed to be poisoned. The child that was run over seemed to be shocked by his injury, but he didn't look toxic. The patient that showed a partial dilatation on the table showed no evidence of a toxic condition.

There is no doubt that if a sufficient dilatation of any of the viscera occurs, a very serious toxic condition results from that. But in acute dilatation it takes place in such a short time that it is hardly possible that they are poisoned by this condition. The evidence that Dr. Lee gives, and other evidence he had seen, seemed to him to rather strongly point to the condition as a secondary one, due to some entirely unknown cause, but brought about indirectly by very many conditions that are in no way associated one with the other.

DR. JOSEPH WIENER had had one or two cases of postoperative dilatation of the stomach in gall-bladder cases. One of them was a lady, fifty-eight years old, who had a violent postoperative dilatation for four days, and on the fifth day, fortunately, she mended and got well. About two months ago he had occasion to operate on this same person again, and she was mortally afraid she was going to get another acute dilatation of the stomach, but she did not.

## NEW YORK SURGICAL SOCIETY

It did not seem to him that the mere swallowing of air would explain the condition entirely, because why do so many of our abdominal cases get it when our other cases do not? A very large proportion of the cases reported this evening have been intra-abdominal cases. A large number of these cases have had intra-abdominal manipulation.

Personally, he believed there is a paresis of the stomach, besides some other factor.

DR. CHARLES HENDEE SMITH thought that acute dilatation of the stomach was not due to toxæmia, reflex action or anything else except a mere matter of air swallowing, or a forcing of air into the stomach through the œsophagus in one way or another. It is perfectly easy to explain that with a conscious patient. The pharynx is so constructed that it cannot contract down on a small amount of food. When the food is solid and goes down in a bolus it fills the pharynx. When the food is liquid, it only partially fills the pharynx, and the pharynx forces air with each small amount of liquid down into the stomach through the œsophagus. The pictures showed that where there is fluid in the stomach it forms a perfect water-lock and prevents the eructation of air when the patient is in the supine position.

The pre-operative cases of distention he would explain simply as due to the nervous swallowing of a patient waiting for an anæsthetic. It is a very nervous time for almost everybody, and we all know that the secretions of the mouth are increased tremendously by any nervous excitement. Some patients simply lie and swallow saliva and air for some time before taking the anæsthetic. Fermentation can not produce gas at so rapid a rate. It must be swallowed air. The pre-operative cases are explainable in the same way, as the air can not escape unless the patient is raised to a semi-erect position. Under deep anæsthesia there must be some other factor, although it is the same mechanism; it is a forcing of air down by the respiratory movements. Everybody who has given an anæsthetic has heard the patient make a gulping sound with each respiratory movement. It is the same kind of a noise a baby makes in taking a bottle. Not all patients do it. There must be some peculiarity about the stomach, whereby there is a valve-action. The diaphragm in descending forces a little air into the stomach and the air is unable to escape. There must be marked atony of the stomach, which allows the stomach to dilate to the extreme degree seen in some cases. Probably there is a moderate distention from these causes in many other cases.

DR. LEON T. LEWALD suggested making a practical application of the negative pressure or aspiration principle to cases of dilatation of the

## ACUTE POST-OPERATIVE DILATATION OF STOMACH

stomach which do not readily respond to the simple passage of a stomach tube or lavage. Dr. Hartwell had just mentioned such a case, in which he had accomplished expulsion of the air by means of direct compression of the stomach. A carefully applied slight degree of negative pressure would produce the same result more promptly and efficaciously. It might be wise to construct a special tube for this purpose, having a number of very small sieve-like openings at the end, in order not to suck the mucous membrane into the tube.

Dr. LeWald had applied this method to cause the collapse of a dilated colon. Dr. Downes was operating on a case of megacolon, and asked him to pass a tube into the rectum. This was done, but no gas escaped, although the tube was a very large and rigid one, and Dr. Downes with his hand in the abdomen could feel the end of the tube free in the colon. Dr. LeWald begged permission to attach the suction apparatus. When this was done the colon immediately collapsed and remained so. Dr. LeWald suggested that the repeated application of negative pressure to a tube in the rectum might offer hope of some permanent relief in megacolon. The same principle would be applicable to cases of acute or chronic dilatation of the stomach.

He believed the mechanism of dilatation of the stomach to be a relaxation or inhibition of the normal tonic contraction of the organ, due to some toxic condition or a reflex nervous manifestation, as suggested by Dr. Douglas. He had seen one case as a toxic fatal complication of measles and bronchopneumonia in a young soldier. The relaxed stomach acted somewhat like a bellows, and thus encouraged the entrance of air from the œsophagus, as suggested by Dr. Smith; but that, owing to the lack of muscular tonicity, it failed to expel the accumulated air.

Dr. LeWald was much interested in the relationship of suppression of urine associated with acute dilatation of the stomach. He had observed a marked dilatation of the colon in several cases of ureteral colic which he had röntgenographed during the attack. Some reflex mechanism apparently allowed the colon to dilate in association with a partial suppression of urine due to a blocking of a ureter by a calculus. In some way the suppression of urine and the somewhat analogous condition to the dilatation of the colon—namely, the dilatation of the stomach—might be associated.

He believed that the Röntgen ray would afford a means of diagnosis in doubtful cases of acute dilatation of the stomach, for, even *without* the administration of any opaque substance, the dilated stomach could be distinguished from dilated small intestine or colon by means of its air content.

## NEW YORK SURGICAL SOCIETY

upper end of the ileum was freshened down to healthy tissue and an end-to-side ileocolostomy was performed, two rows behind and two in front, the outer layer being silk. Closure fairly satisfactory, but some leakage was expected. Patient's condition, however, did not warrant a more prolonged operation.

Five days after the third operation some fecal discharge began, but this gradually lessened and disappeared about a week later. The problem of feeding the patient was a difficult one and was undertaken by Dr. Foster. Her complaints were persistent diarrhoea, marked rectal tenesmus and burning in the rectum. It was impossible at first to get in more than a few hundred calories a day. Opium was given at frequent intervals. For a considerable period koumiss was the sole food. There has been a steady improvement, the daily calories now reaching 2000. The intestines have adjusted themselves to the new condition, so that now the patient has but from two to four semi-formed movements per day. She has gained in weight and is rapidly convalescing.

An examination of the stool, made March 7 by Dr. Stillman, gave the following result: Reaction was alkaline; microscopically there were a few meat fibres, but not more than are normally found. There was very little free fat or fatty acid, practically no soap; no starch. Total nitrogen content 9.6 grams. Result practically normal.

Dr. Flint, in 1912, in the Johns Hopkins Hospital Bulletin, wrote upon the effect of extensive resection of the small intestine and reported considerable experimental work. He concluded that where 50 per cent. or more of the small intestine was resected, serious consequences usually followed. He emphasized the compensatory process which goes on after such operations.

Turck more recently, in 1914, reported a successful case with the removal of one-half of the small intestine and an end-to-end anastomosis. This seems to be one of the most recent contributions on the subject.

# TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY

*Stated Meeting, held March 6, 1916*

The President, DR. CHARLES H. FRAZIER, in the Chair

## IMPROVED METHOD OF CLOSING WIDE CLEFT PALATE MALFORMATIONS

DR. JOHN B. ROBERTS presented an infant to show the result of an operation for closing a cleft palate. He said that cleft palate operations by Brophy's "tie-beam" sutures of the upper jaw had in his work in early infancy cases caused much undesirable suppuration within the mouth, or severe damage to the alveolus. Recently, therefore, he had adopted, as in the case shown, a method by which the wire sutures were introduced from the outside of the cheeks, and were carried through the two upper maxillary bones. The separated portions of the roof of the mouth, being still largely cartilaginous, are drawn closer together by twisting the two wires over corks covered with gauze on the outside of the cheek on each side. Later, these wires are twisted to increase the approximation of the sides of the cleft in the palate and maxillary bones. He had in the two cases buried the twisted ends of the wire beneath the skin, and allowed the cutaneous wounds to have a chance to close, though their union is slow on account of some suppuration. At the time the tie-beams are introduced the cleft in the alveolar process in front is closed by a wire suture, and at a later period the cleft in the lip united by silkworm-gut sutures. The first step in the operation had been done when the infant was about three weeks old, that step being the introduction of the tie-beams and wiring the alveolus. The second step is the closing of the lip at about four weeks and a half of age. The case presented shows the wires introduced and the lip still open. A second patient has had the wires in the jaw for four months with very little irritation, except some slight suppuration of the cheek wounds. The anterior part of the cleft in the roof of the mouth is closed, the alveolus has been brought together, and the upper lip, now united for several weeks, looks very well.

In future he intended to introduce the wires so as to have a twist on one side only, doing this by returning the end of the first wire across



the cleft a second time and having the loop on the second cheek buried at once. He was not sure but that, after taking out the wire tie-beams at the end of five or six months, he would introduce for a considerable period, either another set of wires, or perhaps be satisfied with a heavy kangaroo tendon loop and knot for the two supporting sutures.

He had for a number of years been convinced of the value of Brophy's suggestion to close these wide clefts in early infancy so far as is possible while the upper jawbones are largely cartilaginous. The impact of the mandible against the upper jaw has a tendency to keep the cleft from coming together and, perhaps, widens it. Therefore, early support and approximation of the two sides of the fissure by the prolonged use of tie-beam sutures, and by closure of the upper lip and the alveolus, seem mechanically wise. It seems cruel to make suppurating wounds on the outside of the cheeks of these little patients, but this is of less importance when one thinks of the gravity of the congenital malformation. The dimpled scars in the cheeks, left after healing of the wounds, may easily be made inconspicuous by plastic operation.

#### BONY UNION OF TRANSVERSE FRACTURE OF BOTH PATELLÆ WITHOUT OPERATIVE SUTURE

DR. JOHN B. ROBERTS presented a man aged perhaps 50 years, who last December, while in the Polyclinic Hospital for fractures of the fibula, called his attention to his knees. He stated that Dr. Roberts had treated the left patella with a board splint twenty-two years ago, April 3, 1894, at the Polyclinic, and the right patella for a similar fracture about six years previously with hooks at the Pennsylvania Hospital. On investigation it was found that the man had been in the Pennsylvania Hospital about 1886, when Dr. Roberts, as Out-patient Surgeon, was using the Levis separated Malgaigne's hooks for this fracture, having been taught their value by seeing Dr. R. J. Levis's success in getting close union by means of them. It is possible that his connection with the case at the time was as Dr. Levis's assistant, for he did not remember the patient clearly. The patient still shows evidence of scarring of the skin by the hook points; and the patella is solid, of good shape and the mobility and usefulness of the limb perfect. The left patella is a little larger than its fellow; a shallow transverse groove in it is palpable, and the outline of the periphery is a little distorted. The flexion of this knee is slightly restricted in extent. The man declares that they are both perfectly useful; and, as he is a laborer, this testimony as to absence of disability is worthy of acceptance. The skiagraph plate shows apparently a close, probably an osseous, union of both bones.



FIG. 1.—Condition before operation (about two weeks old).

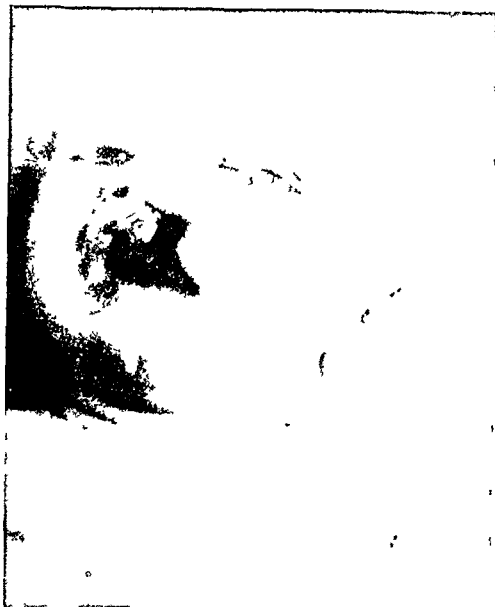


FIG. 2.—Condition when about three weeks old.



FIG. 3.—Condition after first operation (about three weeks old).



## ABSCESS OF BRAIN

At the Pennsylvania Hospital at the time mentioned, about 1880, Malgaigne's hooks were frequently employed during a number of years by T. G. Morton and R. J. Levis, and also by the reporter, following them, with great satisfaction. Since that time he had used adhesive straps to hold the fragments together, and applied a posterior splint of wood or of gypsum and gauze, as was the case in this man's second fracture. At other times he had used a circumferential subcutaneous suture in the coronal plane, or had exposed the bone by incision and sutured the periosteum and muscles. The last has been done as an exception. In all cases the rectus femoris muscle is kept relaxed by flexing the hip-joint during treatment.

He thought this case sufficiently interesting to present to the Academy because of the vigorous opposition of many to the employment of non-open treatment of this fracture. Two united and useful broken patellæ, one of twenty-two years' and the other of about twenty-eight years' standing, giving a laboring man no disability sufficient to attract his attention, are surely eloquent witnesses to the value of subcutaneous or non-operative treatment.

## ABSCESS OF BRAIN

DR. J. STEWART RODMAN presented a woman, 30 years of age, who was brought to the Presbyterian Hospital in a dazed condition, having fallen shortly before, striking her head on a wash-tub. The following day, when her history was taken, she was fully conscious, and answered fairly well. The upper part of the left side of the face involving the forehead was swollen and ecchymotic. Fluctuation was obtained over left malar bone. No crepitus—no increased tenderness.

*Eyes.*—Right, normal. Left eyelid swollen and ecchymotic. Marked subconjunctival swelling. Pupil reacts sluggishly to light. No discharge from ears or nose. Thorax, abdomen and extremities negative; no paralysis; pulse regular, good volume—80.

*Spinal puncture*, day of admission; 10 c.c. fluid obtained under moderate pressure and slightly blood tinged.

*X-ray* showed fracture of left malar bone, and fracture (possible) of sphenoid.

During the following three weeks there was gradual absorption of the swelling over malar; irregular type of fever. Mentality good for two weeks, then drowsiness and beginning difficulty in speech, and weakness on right side. Appearance of swelling, giving fluctuation in left temporal region.

*Examined by Dr. Cadwalader* three weeks after admission.

## PHILADELPHIA ACADEMY OF SURGERY

Result of neurological examination, incomplete paralysis right side face, arm and leg. Reflexes exaggerated left side. No Babinski. Sensation uncertain because of mental condition. Understands what is said to her and recognizes objects. Cranial nerves react normally.

*Diagnosis.*—Depressed fracture of left temporal bone or hemorrhage without fracture. Possible encephalitis or cerebral abscess from infection travelling from sinuses.

An exploratory craniotomy was done by Dr. Rodman. Vertical incision through the centre of the left temporal swelling. A large collection of pus under scalp was evacuated. A fracture of the left temporal bone was exposed. The fracture opening in skull enlarged by a rongeur and the bulging and tense dura was opened by a criss-cross incision. The brain cortex bulged into wound. Convulsions flattened out. Exploratory puncture: Reached greenish pus about  $2\frac{1}{2}$  to 3 cm. below surface of cortex. Incision then made into cortex and about 2 oz. of greenish pus evacuated. Rubber tissue drain to abscess cavity. Scalp incision closed with interrupted silkworm gut.

*Postoperative Course.*—Temperature remained normal. Could talk following day with some hesitancy; afterwards speech normal. Sixth day following operation, slight convulsion lasting few moments; twitching of face and both hands; pupils dilated; inability to speak; pulse weak; lasted only a few minutes. On the tenth day following operation, slight twitching of facial muscles; lasted ten minutes; fully conscious. After this, recovery entirely uneventful. Original drain undisturbed for three weeks. At that time drainage ceased and drain removed.

Culture of pus from abscess of brain staphylococcus albus.

## SARCOMA OF LEFT HUMERUS AND FEMUR

DR. RODMAN presented a woman forty-nine years of age. Had suffered from pain in her left shoulder for three years. Two years ago first noticed a swelling of this shoulder. She thinks swelling is now little if any larger than when first noticed. During this past summer, July, 1915, a swelling developed gradually above her left knee. She tripped and fell in July, 1915. Following this her knee became swollen, but in about a week she was able to get about with the help of a cane and crutch. Fell again one week prior to admission, striking her shoulder and thigh. After this fall, both shoulder and thigh painful. When admitted, she was rather emaciated; her left shoulder was symmetrically enlarged and pulsated. A loud bruit could be heard over the swelling. Systolic murmur heard in left supraclavicular triangle and

## ERROR IN ABDOMINAL DIAGNOSIS

also in left suprascapular region. Little, if any, limitation of motion in left shoulder-joint, but some muscular weakness. Just above and including the left knee the diameter of the part was increased by one-half by a symmetrical swelling. Not tender; no apparent pulsation, but a loud systolic murmur heard over entire swollen area. Unable to bear weight on the left leg because of pain. No crepitus nor preternatural mobility.

*Diagnosis.*—*Osteo-angio sarcoma* of left humerus (primary) and left femur (secondary).

### RICHTER'S HERNIA. ACUTE INTESTINAL OBSTRUCTION

DR. RODMAN presented a third patient, a woman, sixty-eight years of age, who, until two days prior to admission, had been enjoying her usual good health. She then developed sudden severe lower abdominal pain, cramp-like in character. Vomited frequently during the day of onset and also during the following day. Pain also continued. Was given purgatives but was unable to have a bowel movement. Abdomen became distended.

Two hours after her admission to hospital Dr. Rodman made a midline incision between symphysis and umbilicus. On opening the peritoneum, free fluid escaped, and distended coils of small intestine crowded into the wound. On pushing these aside, collapsed small intestine was found which was traced to the left internal ring. There bowel had become caught by a prolapse of one wall into the opening (Richter's hernia). Gentle traction was sufficient to disengage the bowel. The dark area where that bowel had been caught (one wall) was infolded by interrupted Lembert stitches of Pagenstecher. Wound closed without drainage. Recovery uneventful.

### HANDLING OF CHILDREN WITH TUBERCULOSIS OF THE SPINE WHILE THEY ARE UNDER THE INFLUENCE OF AN ANÆSTHETIC

DR. WALTER G. ELMER read a paper with the above title, for which see page 34.

### ELEMENT OF ERROR IN ABDOMINAL DIAGNOSIS

DR. HAROLD L. FOSS read a paper with the above title, for which see page 39.

DR. JOHN H. GIBBON said that anyone who looks upon abdominal diagnosis from a fair point of view, must agree that the surgeon who makes no mistakes is either more or less than a man. Mistakes are

made not often because we do not know the difference between two conditions, but because we do not devote enough time to the study of the case. It is fortunate in many ways that surgeons forget their mistakes, yet it would be a good thing if we had them constantly before us. The speaker presented before this Academy some time since a paper on perforated duodenal and gastric ulcers. Yet within a year he operated upon a case in which he was satisfied with the removal of an appendix that was acutely inflamed and covered with lymph. The man died and an autopsy showed a perforated duodenal ulcer! Surgical judgment and common sense are also absolutely necessary in order to avoid mistakes in surgery. The less a man knows about a thing, often the more confident he is. The man who is overconfident does not recognize his mistakes. Self-satisfaction, carelessness and haste are bad things in surgery. Out of dissatisfaction with one's self will come improvement. That a patient may pass through many hands without a correct diagnosis of his condition being made was illustrated ten days ago in the case of a man who for fifteen years had had attacks of severe pain in the upper abdomen. He had become a "neuro," of course, in that time. One man had passed him on to another, each recommending his favorite treatment; meanwhile the man's neurasthenic symptoms had become very pronounced. He finally fell into the hands of a bright woman physician, who suggested having an X-ray picture taken, and 17 gallstones could be seen in the plate, and were promptly removed. In operating for appendicitis the surgeon has to keep in mind that, even if he is right in his diagnosis of chronic or subacute appendicitis, there may be something else present. The first three or four cases of ureteral stone the speaker operated upon had been diagnosed appendicitis and in two of them the appendix had been removed.

DR. JOHN H. JOPSON said that it is undoubtedly true that many errors in diagnosis in abdominal lesions, as elsewhere, are attributable to haste and carelessness; and, it may be added, sometimes to mental and physical fatigue. Pirogoff emphasized this many years ago in connection with his report of a femoral aneurism which he had opened in mistake for an abscess. It will also seem that the distance between the brilliant diagnostician and the conscientious plodder is being greatly lessened by the general adoption of exact laboratory methods, and especially by the use of the X-ray. It is equally true that the question of judgment in the interpretation of laboratory as well as clinical data, skill in physical diagnosis by personal methods of examination, and the personal equation generally, will never be eliminated by any methods of research.

## ERROR IN ABDOMINAL DIAGNOSIS

Regarding gastric and duodenal ulcer, he gathered from Dr. Foss's statistics that in ten cases of his series a diagnosis of ulcer had been mistakenly made where other lesions were proved present at operation. Only three times had ulcer been found when some other pre-operative diagnosis had been arrived at. This bears out his own conviction as to the chances of an obscure lesion being ulcer or something else. When the differential diagnosis between ulcer, gall-stones and appendicitis is puzzling in the absence of certain confirmatory symptoms, the chances are several to one against ulcer being present.

In connection with the diagnosis of gall-stones, he had been much interested in the papers of Cole, who points out that 20 per cent. can be detected with comparative ease by the use of the X-ray, due to the presence in the stones of the calcium salts. In the remaining 80 per cent. the greater density of the bile itself to the X-ray renders it necessary to demonstrate the negative shadow of the stones and the so-called "bunch of grapes" appearance which they present. After much experimentation with gall-bladders removed from the body, immersed in water and bile, Cole arrived at a technic which he thinks fairly reliable, and in fifteen cases in which he made the diagnosis of gall-stones in cases referred to him for the purpose of diagnosis, in twelve his opinion was proven correct when the patient came to operation. It would, however, be interesting to know in how many cases, in which he failed to make the diagnosis, gall-stones were afterward shown to be present.

As regards the percentage of errors, the speaker had been interested in hastily looking over fifty consecutive histories of his own private cases of abdominal operations to determine how many gross blunders in diagnosis he had made. There were six cases in which such an error in diagnosis was demonstrated, or 12 per cent. These errors included a case of acute hæmatosalpinx in early unruptured extra-uterine pregnancy, diagnosed acute appendicitis; appendicitis and general peritonitis diagnosed probable nephritis with complete suppression of urine and abdominal symptoms; a case diagnosed perinephritis, in which nothing definite was found, but the patient improved after appendectomy; a case diagnosed subphrenic abscess, which recovered, no abscess being found; sarcoma of the transverse colon, with perforation and circumscribing adhesions, diagnosed gall-bladder disease; sarcoma of the stomach, diagnosed as ulcer and hour-glass stomach. In the last case there were three separate nodes of sarcomatous tissue in the stomach wall, with irregular contraction of the same between them, producing an X-ray appearance simulating hour-glass stomach.



## PHILADELPHIA ACADEMY OF SURGERY

### FRACTURE OF THE FEMUR

DR. W. L. ESTES, of St. Luke's Hospital, South Bethlehem, Pa., read a paper with the above title, for which see page 74.

DR. GEORGE P. MÜLLER said that most of the mistakes one sees in consultation practice are due to the neglect or inability to use the X-ray. Dr. Estes has accurately formulated the indications for operation. In oblique fractures of the femur it is practically impossible to effect satisfactory reduction. Dr. Martin has stated that where a fracture can be reduced and held, there is no necessity of doing anything further, but if it is not held then means should be taken to this end. It is at this point that the speaker became radical in his opinion. There is no use waiting week after week, and trying method after method to reduce and hold a fracture of the femur, humerus, or tibia. At the end of this time there is hopeless shortening with the prospect of a dangerous operation; whereas, if the irreducibility is recognized at the end of the first week, an operation will correct the deformity or displacement, can be easily done, and will give practically perfect results.

Dr. Estes spoke of the bowing of the femur, and he had tried to take advantage of this by proper support during the application of the plate. Dr. Roberts has stated that the ideal method of the future will be the use of some absorbable fixation material which will hold the fragments accurately together, and he mentions the use of fascia and of catgut. Such fixation material is, however, too weak to stand the strain of the force exerted by the leverage action of a long bone. No one has introduced a method superior to the steel plates now in use. He did not believe in the common statements that the plate, *per se*, prevents callus formation, nor that the screws induce necrosis or softening of the ends of the fragments. He had made some very interesting observations upon a small series of cases, carefully studied, which show that it is not the plate but the absolute fixation that prevents callus. As to necrosis, this complication is due to infection and not to the presence of the screws.

DR. JOHN B. ROBERTS discussed the third and fifth propositions of Dr. Estes's paper. The former raises the question of the importance of general management of fractures of the femur; the latter discusses results, period of disability and the relative value of the bloodless (non-operative) and the blood-letting (operative) methods of treatment.

Dr. Roberts said that he had a firm conviction that the serious nature of the mechanico-physiologic problems presented by a broken thigh bone is not realized by those surgeons who leave this portion of the treatment to the discretion of an inexperienced hospital interne,

## FRACTURE OF THE FEMUR

a nurse, or a hospital orderly. It is largely this negligent attitude of hospital surgeons which has made statistics when collected from many sources so discouraging. These statistics have driven a considerable proportion of surgeons to adopt incision, with direct fixation by means of metal plates, as a routine treatment. The same type of fracture treated by non-operative means in private practice is followed by better cure, because the responsibility is more direct, the pecuniary reward greater, and censorious criticism more likely. The recently enacted Workingman's Compensation Law in Pennsylvania will indubitably improve statistics by fixing the attention of hospital surgeons on this item of fracture treatment.

Dr. Estes's fifth proposition is concerned with the disability after fracture of the femur, and the relative value, as to functional cure, of the non-operative and the operative or open methods of treatment. It comprises, indeed, the most important topic of his admirable address. This phase of the discussion was of supreme interest to him for the reason that of late years he had been compelled to take a stand which would seem to show that his opinion as to fracture treatment had changed on the question of operation. Years ago he was an advocate of the profession operating by incision upon fractures, although few men operated for this lesion of bones. Now, however, he was constantly declaiming against the frequent use in surgery of fixation of fractures of bones of the extremities with metal plates. The fact is that his opinion has differed very little from that which governed his practice in the earlier years mentioned, except that he operates now rather more frequently than he formerly did. The trend of events, or what he might call a curious herd-like or gregarious change of opinion, has caused many practitioners of medicine and surgery to rush into operative treatment of all kinds because of a mistaken view of the part which nature plays in the cure of many medical, and a considerable number of surgical, lesions. The human mind is apt to be so swayed by the shifting winds of popular thought on the one hand, or set like gypsum, by routine and non-appreciation of psychic movements on the other hand, that many cease to grow mentally, or have our mental development actually choked as the vines of a jungle destroy young growing trees. We cease to think in terms of logic, and are either controlled by a stony conservatism, or follow the lead of some great operator with a tarantella-like childishness. Personally, he believed that the furore for operative treatment of fracture of the femur and other long bones is about to lessen, and that within the next decade fewer fractures of long bones, rather than more, will be subjected to

operative attack as a routine of treatment. Scarcely more than 15 or 20 per cent. of closed fractures of long bones need be treated by operative incision for reduction and fixation. The bloodless or subcutaneous treatment is sufficient in skilled hands, with careful general treatment and frequent observation, for about 80 or 85 per cent. of broken bones of the extremities. The essentials on the part of the surgeon are that he, when undertaking to treat a fracture, look at a bare bone, remember the muscular attachments in the neighborhood, compare the limb with the normal limb on the opposite side, give an anæsthetic to determine the presence or absence of fracture, and the probable line of break if one exists, reduce the fragments so that the injured limb looks like the normal one, steady the bones with contour splints or gypsum gauze with or without traction as the case may be, examine the position every day for the first week, and at less frequent intervals later, and use light massage and careful mobilization of joints from the beginning to the end of treatment. A great aid to anæsthesia is the use of the X-ray to prove the existence of fracture and to check up the results of his anatomical examination under ether. Too much reliance, however, must not be put upon this method of examination. The surgeon must have some knowledge of X-ray appearance of bones, and will need to connote his knowledge of anatomy with the radiologist's knowledge of shadow pictures. It is probable that a practitioner with a good knowledge of bare bones and their muscular attachments, and with the mechanical instinct of the carpenter and plasterer, will do better without radiography than a radiographer without a knowledge of the practical side of surgery. The man who has the knowledge of the X-ray expert to help him, will, however, be often benefited. The greatest defects in hospital treatment of fractures of the femur are the sagging spring-mattress on the bed, an ignorant orderly with a douche-pan instead of a bed-pan, and a careless attention to steady traction. The drumhead canvas bed-frame adjustable to the ordinary fracture bed, so as to give counter-traction, used by Dr. E. A. Bryant, of California, is a cheap way of solving some of these difficulties (see Fig. 4). In operations for the exposure and treatment of deformed fractures of the femur, with long-standing contraction of muscles, he knew of no better way for continuing strong traction during application of the metal plate, after the malunion has been cut apart, than the Levis thigh plate and compound pulley (Fig. 5). This gives an easy method for maintaining the extension during the application of the necessary fixation by metal plates.

There is a great need for some form of absorbable mechanical

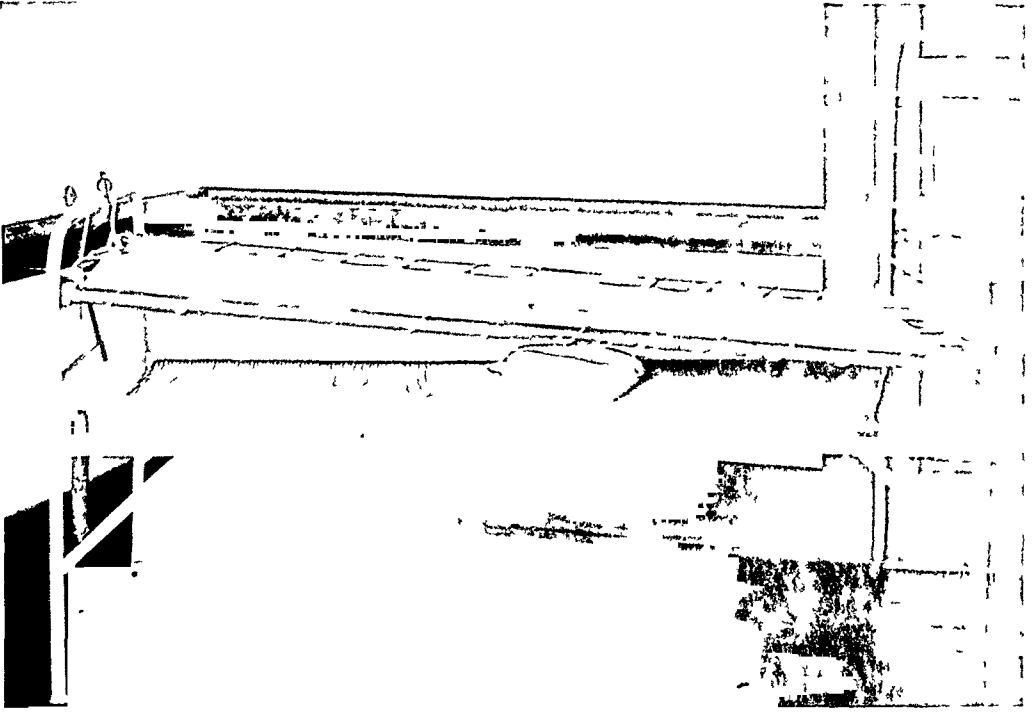


FIG 4.—Drum-tight canvas and gas-pipe frame used by Dr. E. A. Bryant of Los Angeles, Cal., for reducing countertraction in fractures of the femur. Notice how it is hooked upon the braces of the head and foot pieces of the ordinary metal bed and thus obtains counterextension by the weight of the patient's body. Beneath it on the spring mattress of the bed may be placed any sort of a receptacle for feces, since the canvas has an opening through which defecation may take place. The Buck's traction apparatus is attached to the limb of the patient by adhesive plaster and a stirrup, in the usual way.



FIG. 5.—Method of reducing overlapping fragments of a fractured femur when operating for fixation by plate and screws. The Levis traction plate and a set of compound pulleys make the reduction easy.



## FRACTURE OF THE FEMUR

support applied directly to the broken bone that will give fixation and prevent overlapping as does the metal plate with screws. The osteogenetic inlay of Albee will often be found valuable, particularly in malunited and ununited fractures. He had suggested some variations in shape and material of plates, such as using aluminum instead of steel; and he had applied an artificial periosteum made of a graft or transplant of fascia lata taken from the opposite thigh for maintaining a fracture in reduction. It should be borne in mind that the fixation appliance is to prevent overlapping and rotary or lateral or antero-posterior displacement, rather than to give perfect rigidity. Hardly anyone depends upon the plate to give rigidity, but for that purpose uses the gypsum encasement or some form of rigid external support in addition to the fixation plate. Traction is usually employed after operation to prevent recurrence of overriding in femoral fracture. Another misconception of the problem is a too rigid belief in the value of measuring with tape measure or other standard unit. The shortening of a man's leg may be in the femur, or in the tibia, or in both. If the patient is placed squarely on his back, with legs extended and the line connecting the anterior spinous processes of the two ilia at right angles with the long axis of the body, the surgeon's eyes may readily see whether or not undesirable shortening exists in the femur by comparing the relative positions of the two patellæ. This is as easy as telling whether a large picture hanging on his office wall is horizontal, and throws out of account a possible difference in length of limb due to asymmetry of the tibias.

The surgeon should not forget in reconstructing a femur that the normal femur of muscular individuals is arched forward. This is seen when the shaft is viewed laterally. He was one of those who believe that it is hardly necessary for a man to carry a large amount of steel buried in the muscles of his leg after the bone has united. He saw, therefore, no particular reason against cutting down and taking a steel plate out of a man's thigh after union has been secured. This must be done, of course, with an aseptic technic, and is more necessary in those whose occupation takes them away from surgical observation than in those whose business and residence permit them to have surgical aid at hand in the event of future trouble from the buried metal splint.

DR. A. P. C. ASHURST regretted that Dr. Estes did not have time to go more fully into the question of fractures of the neck of the femur, a subject which often is overshadowed in interest by fractures of the shaft. In fracture of the neck more emphasis should be placed upon keeping the patients in bed until union occurs; but remaining in bed is

not alone sufficient to secure union. The primary impaction, which results from the accident, often is slight, and if no efficient treatment is instituted these patients will recover, or rather fail to recover, with non-union. In primarily unimpacted fractures Cotton, of Boston, has undertaken to hammer on the trochanter with a wooden mallet until he produces artificial impaction; his reported end-results so far are few, but encouraging. But the idea of a hammer is not very attractive, and for the last five years he had been practising Cotton's artificial impaction in what seemed to him an equally efficient but less theatrical manner: he had found it sufficient to anæsthetize the patients, reduce the fracture in the ordinary way, and then simply abduct the limb until one hears the bones crunch, when the fragments will stay together; they are then held in this position by a gypsum dressing. Now the question arises, what patients will stand all this? His first patient was a lad of fourteen years; he secured an anatomically and functionally perfect result, except for 0.5 cm. shortening, and moderate loss of abduction, which inconveniences him not at all except in gymnastic exercises. Any reasonably healthy patient up to sixty years, perhaps older, will stand this method. Even in the case of impacted fractures with deformity, in such patients, the position of the fragments should be improved by this method.

Next, in the case of patients who cannot endure such radical treatment, the surgeon should not wash his hands of all responsibility for securing a useful limb. If they are abandoned to themselves non-union is inevitable. For these cases no method is so satisfactory as that of Phillips, Maxwell and Ruth. Under this treatment, which can be instituted in every case, no matter how feeble the patient, a certain proportion of fractures, even when entirely intracapsular, will result in union without impaction, *provided one first reduces the fracture*. Attention must be given to flex the hip up to about a right angle, make vertical extension upward, and finally bring the limb down in abduction and inversion; then apply the Phillips dressing, with an apparatus like Volkmann's sliding splint, to prevent outward rotation of the limb.

Old fractures at the hip, with non-union, usually are the result of inefficient treatment when the fracture was recent, as has been repeatedly pointed out here by Dr. G. G. Davis. Such patients deserve to be treated more energetically than heretofore. Many of them are otherwise sound physically. Two operative procedures are open to us: one for patients who will endure long fixation, the other for those who will not. (1) The speaker had done three bone-peg operations for non-union: the first patient was a man of 30 years, and is the only one

## FRACTURE OF THE FEMUR

with an entirely satisfactory result. He has some shortening and a little limp, but with good solid union was able to return to his work less than a year after operation. The second patient was 42 years old, and though he seems to have solid union, without much shortening, he seems to have no intention of returning to work so long as he can find someone to support him. The third patient, aged 52 years, returned to work (cigarmaker) about six months after operation, and though he uses a crutch on the street, requires no support walking about the house. (2) In patients incapacitated by non-union of neck fractures there is another method of treatment suitable for those who cannot endure long confinement to bed after operation. This is simple excision of the head fragment, as advocated by Lambotte. The patients can then be gotten out of bed in ten days or two weeks, and though walking with a limp, and perhaps requiring a crutch, are said to be markedly relieved of their pain and disability.

Finally, in regard to fractures of the shaft, he inquired of Dr. Estes whether he thought the condition of the soft parts (in simple fractures with much swelling) is improved by early operation, say on the first to third day, or whether it is better to wait until the swelling has subsided of itself, which may be in such cases as late as the fifteenth day. Lambotte claims for the operative treatment of recent fractures, when once the form of the bone has been restored by an absolutely rigid support applied directly to the shaft, that it enables the surgeon to disregard the bone and to take care of the soft parts as if no fracture had existed. He goes so far as to say that he believes that when a femur has been properly plated, it would be possible for the patient to walk on it the next day; but he adds that it is not expedient to make the experiment. This theory (that rigid fixation of the bone enables one to eliminate a fracture as a factor in the subsequent treatment and to pay proper attention to the soft parts) is seductive, but in practice it cannot always be carried out; and in most fracture operations, especially those involving the femur, external retentive apparatus is required, and in difficult femur cases he had seen Lambotte himself apply plaster-of-Paris dressings. Yet he believed that when a plate tears out it is the fault not of the plate but of the surgeon, who did not put it on correctly. In most such cases one or two screws have been used, where there should have been six or eight; or else the plate has not been placed across the obliquity of the fracture, so as to bring the pull of the fragments in a plane at right angles to that in which the screws are inserted. In cases where the fragments are difficult to retain, there need be no limit to the amount of internal fixation appliances employed; several



plates may be used, or the plates and fragments both may be encircled with wire. So long as rigid fixation is secured, so long as the metal is sufficiently covered by the soft parts, and so long as no infection occurs, there is very little likelihood of the plates subsequently requiring removal. Of course a plate *may* work its way out years later. Dr. Edward Martin had told him of a patient who came to him seventeen years after Dr. John Ashhurst had inserted a plate in his leg; only after that long interval did it begin to cause trouble. But even if a plate may remain quiescent for so many years and then begin to work its way out, one does not have to abandon the use of plates on that account. They are in my opinion the most reliable means of fixation for recent shaft fractures.

DR. ESTES in closing, said that the Steinmann nail is being used much abroad at present in the cases of terrible shattering of limbs, and with excellent results. This frequent use is because of its easy application.

In treatment of fractures of the neck of the femur the most satisfactory treatment is by the old Hodgen splint. By this method any degree of abduction desired can be secured. It also carries out the idea of Murphy, by bringing the two fragments of the bone together. He agreed with Dr. Roberts in what he has said concerning the open operation. But the men who treat fractures most, who have the largest clientèle of fracture practice, are doing the open operation more and more. It seemed to him that the revelations of the X-ray have rather disturbed former belief in our excellent results. His paper stated that there was always danger of infection in the open operation and that always should one attempt reduction by the closed conservative procedure before attempting the open method. After proper reduction, proven by skiagram, there is no reason for doing the open operation, provided one can hold the fragments by some apparatus.

The fascia fixation mentioned by Dr. Roberts is excellent in some bones, but is not sufficiently rigid in the large bones.

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## PREPAREDNESS

THE PRESIDENTIAL ADDRESS DELIVERED BEFORE AMERICAN SURGICAL ASSOCIATION,  
WASHINGTON, D. C., MAY 9, 1916

BY ROBERT G. LE CONTE, M.D.

OF PHILADELPHIA

THERE would seem to be but one fitting subject for the address of the President of the American Surgical Association at this time; a topic that is in every man's mind, that is daily discussed by the press of the country, and which is likely to be the key-note in the selection of candidates for the next Presidential election, namely, preparedness.

What is preparedness? To increase the efficiency of the military establishment of the United States.

Why should this be done? That our citizens may be safeguarded and permitted to enjoy life according to our laws; that we may be protected from foreign aggression or oppression; that the principles upon which our nation was founded shall be maintained in the world; that international law, which no longer exists because it cannot be enforced, shall be re-established, and this will take might as well as right.

If our country is to continue to be a power among nations it must have a trained force commensurate with its power, an army, and, above all, a navy of sufficient strength in ordinary times to make its word respected. For extraordinary times of national peril, it should have at its command a sufficient body of trained citizens to meet that peril and avert it, or overcome it. The art of war is as much a science as the art of medicine, and its changes in the past twenty years are quite as pronounced as those in medicine. It is foolish to suppose that men versed in the elementary rudiments of a science can compete with the trained scientist.

When bubonic plague threatened to invade the United States on the Pacific Coast, did the Government send first-year medical students to combat it? On the contrary, educated laboratory men and scientists of the highest medical ability were sent, and promptly exterminated the threatened invasion of a great plague.

To-day there is raging in Europe the greatest pestilence that has ever visited the earth. It is costing millions of lives, devastating whole countries, impoverishing every nation that is in its grip, and what are we doing to prevent its spread to our shores?

We have a handful of men trained to combat it, and Congress has been debating for a year or more whether we shall double that handful and make it two handfuls. It is like having a few drugs in ounce bottles neatly labelled on a shelf, when tons of medicine are needed.

The present war in Europe has taught the world nothing if it is not the lesson of preparedness. This country has never entered a war in a state of preparedness, but has a lack of preparation ever prevented our going to war? To argue that preparedness for war invites war is as logical as preparedness for an epidemic invites the epidemic. The war in Europe has brought about tremendous changes in national life and, unless we prepare to meet these changes and safeguard ourselves, our present national existence may cease, and we may disappear from the face of the earth as did the mammoth lizards and mastodon, and for the same reason, inability to adapt themselves to the changes in their surroundings.

For more than a year before the European war started, Germany's plans for the invasion of Belgium were decided upon, but not before a careful study had been made of the preparation and defences of both Belgium and Switzerland. What saved Switzerland from destruction was no love for her people or high regard for her nation, but her national policy of universal military training, with the thoroughness of her preparation. Had it been easier to go through Switzerland, the first attack would have been on the Swiss, not on the Belgians. With a population of 3,700,000, Switzerland can place in forty-eight hours a quarter of a million men in the line, and have two hundred thousand more in reserve. They acknowledge the principle that every man owes something to the nation's service, and their military establishment costs about \$7,000,000 a year; a cheap insurance from national destruction.

I have heard a great deal of pacifist talk like this: What do you want to prepare for? Who is going to fight us? Do we want this country ruled by the military? etc., *et ad nauseam*. Would any of these people cross the ocean on the finest steamer in the world that lacked life boats and life belts, on the assurance of the captain that no storm or fog, collision or iceberg would hurt the ship? Yet the chances of the vessel reaching its destination safely are surely 100 to 1, perhaps 1000 to 1, on any given voyage. But who can foresee on which particular voyage the life boats will be needed? Put our nation in the

## PREPAREDNESS

place of this ship, with the captain and officers clamoring for adequate life-saving apparatus. Would any passenger embarking oppose the preparations of the captain? Are we not all in the same ship?—and, because some of us want adequate protection must we be called fools and other things by the pacifists? For many years Lord Roberts advocated universal military training in England. His opponents were always asking, "Whom are you getting ready to fight?" He could not tell then, but they have their answer now.

When the European war ends, the United States is going to have most of the money in the world, and some of the nations in Europe are going to have most of the shells. If we are not prepared with an adequate navy and army, it will be easy to convert shells into money at our expense. In the old days it took two to make a quarrel and a fight, but now one nation when ready can impose war on another, and the pretext is nominal or immaterial.

Unless universal military training is made a national policy, this country will never be prepared to meet a first-class power in conflict. No other system can be considered as more than a make-shift or a stop-gap, a source of delusion, but not of safety. Any attempt to depend upon a volunteer system will fail, admirable as the volunteer spirit may be, for it means the organization for war after war is upon us, and transferring the burdens of war to the time of war, a policy which spells defeat. Universal military training modelled on a system similar to that of Switzerland or Australia is the only logical remedy. It is the basic principle of defence upon which the democracy or representative government rests. It will lead unquestionably to better citizenship, to better physical development, to a reduction of crime, and will give to each man an education which the public schools do not supply, something worth more to the individual than reading, writing and arithmetic, for it will teach him obedience, self-control and patriotism, and does education hold three more important things in the preparation of youth for manhood? This service must be obligatory, one that all men owe the nation during a certain period of their lives. They must understand that military service is like any other service to the nation, if the country is to be successful. A real war, a war with a prepared nation, will not be successfully fought by the United States until that principle is in every man's head and has been acted upon.

The present strength of the medical corps of the army is 443 medical officers and one Surgeon-general. In 1908 this number was authorized upon the basis of an army of 65,000 men. This was on a ratio of .7 of 1 per cent. of medical officers to the enlisted strength. Since the

passage of the above Act the army has been increased about 50 per cent. without any increase in the medical corps. This has reduced the ratio of the medical corps to less than .5 of 1 per cent., a ratio entirely inadequate to the proper performance of its duties, so inadequate that it has had to supplement its personnel with officers from the medical reserve corps and with contract surgeons. The department, therefore, in time of peace is so near the breaking point that it has had to call in outside assistance.

The conflict in Europe has shown that .7 of 1 per cent. of medical officers is not sufficient for war, and that 1 per cent. should be the minimum. Again, the mortality in medical officers has been almost as high as in the line. France, in the first six months of the war, lost 1300 medical officers out of 6500, a loss of 20 per cent. of the staff.

Proper training for a staff corps is just as important as proper training for a line organization. An untrained personnel in the medical corps invites and assures a breakdown in this branch under the strain of war. Disorganization will result, followed by the demoralization that always occurs where one or more branches of an army prove incapable.

The requests for an increase in the medical corps have been met with the argument that such increase was unnecessary, for the reason that in our country there are thousands of medical men who in time of emergency would tender their services. The duties of the military surgeon are vastly different from those of a civil practitioner, and no one in civil life can take the place of a trained medical officer unless he has had that training. The purely professional work can be handled by civilian practitioners, but they cannot fill the supervisory positions which in war, even more than in peace, imperatively demand a thorough familiarity with the process of military administration. Unless medical officers sufficient in number for these positions in time of war are provided and trained in time of peace, when war comes men untrained in military administration must be called upon to fill these places, at once putting the medical department upon a volunteer basis at the very beginning of hostilities, with the assurance of the same demoralizing results that have always followed that procedure.

The available supply of medical men in the United States is decreasing, not only relatively to the population but also in absolute numbers. In the last eleven years the number of medical students has decreased 47 per cent., which, with the relative increase in population, means that to-day we have one graduate in medicine to 28,000 people, while in 1904 we had one graduate in medicine to 14,000. The position the United States is in regarding available medical men is rapidly

## PREPAREDNESS

approaching the condition that England is now in, not enough practitioners for the civil population and the army. England was compelled to call upon Canada, Australia and New Zealand for large numbers of medical men, and, when this failed to fill up the necessary complement, they turned to us for assistance.

To produce an efficient medical department in time of war, trained officers must be provided in time of peace, in numbers sufficient to form a nucleus for expansion to meet the needs of war. Such expansion cannot be accomplished with trained officers sufficient only for the ordinary duty in time of peace. Failure to acknowledge this principle is bound to bring reproach upon the country, by again producing the conditions that disgraced the first two years of the Civil War, and also the Spanish War. The Spanish War, although a short war, was an example of too few trained men to properly meet the demands of war. The army then was expanded within a few weeks to about ten times its peace strength. The medical department broke down. Civil practitioners volunteered by the thousands but were unable to do the work of the trained military surgeon.

These are the statistics of the shortest and in many ways the most successful war we have ever waged. From the time the Maine was destroyed until peace was declared was about five months. Our deaths from battle were 293; our deaths from disease were 3681, of which 2649 occurred in military camps in the United States, among volunteer troops and recruits who never saw the firing line. If we take the mortality from disease as 10 per cent. it would represent 37,000 cases of illness to 293 deaths from wounds. There are many things which account for these figures, but the most potent to my mind is medical volunteers, untrained in the art of military medicine, camp sanitation, hygiene, etc., associated with volunteer troops who have not the knowledge to care for themselves in the field. Imagine a preparation so inadequate that it made it 10 times more dangerous to live in camp in the United States than to be on the firing line in Cuba.

How can we and the medical profession in the country aid our medical corps? First, by joining the Reserve Medical Corps of the Army or Navy. Second, when your commission is received do not for one moment imagine that makes you a military surgeon, except in name. Study, application, time and money are needed and must be spent in correspondence schools, work in armories with the medical corps of the National Guard, summer instruction camps, etc. What is needed is fitness to take your place in an organized department and not individual brilliancy in your civil specialty. The Department will

supervise your training, but you must do the rest. Third, the formation of units which will be prepared to take charge of a base hospital of five hundred beds. This must be done in affiliation with the Red Cross, as the medical department of the Army has not the authority to make such enrollments. Several of these units have already been formed, but many more are needed.

A committee has been appointed, composed of members of some of our national societies, to inventory the names of the medical men in the country, the hospital supplies, the hospital facilities, etc. You must aid this committee in every possible way and urge upon all good men the importance of joining the Reserve Corps.

The medical personnel in the Navy is 345 officers, with 113 in the Reserve Corps, and the expansion in the Navy will necessarily be limited by the number of ships. The Reserve Corps of the Army has about 1700 officers, and the Surgeon-General desires at least 20,000, for the Army in time of war will be expanded ten, twenty, perhaps fifty times its present number.

Success in war is the result of adequate military preparation followed by effective military operation, and the plans of the general staff for effective military operation are dependent on the medical corps keeping the troops healthy, and the speedy disposition of the sick and wounded. In the Dardanelles campaign the British removed in six months 78,000 sick, and this sickness was perhaps as important as any other factor in the abandonment of the campaign. While others talk preparedness, let the motto of the medical profession be, "We are preparing." And why should we prepare? Because our country needs this service. Because we are almost as important to the fighting line as guns and ammunition. Because our calling makes us ever ready to treat the sick and injured, and to subordinate self to that ideal. Because we are patriotic and true Americans. And what is true Americanism? I will answer this in the words of one of our most gifted writers and loyal patriots (Dr. Henry Van Dyke, Oration Delivered on Washington's Birthday, 1906, at the University of Pennsylvania) :

True Americanism is this :

To believe that the inalienable rights of man to life, liberty, and the pursuit of happiness are given by God.

To believe that any form of power that tramples on these rights is unjust.

To believe that taxation without representation is tyranny, that government must rest upon the consent of the governed, and that the people should choose their own rulers.

To believe that freedom must be safeguarded by law and order, and that the end of freedom is fair play for all.

## PREPAREDNESS

To believe not in a forced equality of conditions and estates, but in a true equalization of burdens, privileges and opportunities.

To believe that the selfish interests of persons, classes, and sections must be subordinated to the welfare of the commonwealth.

To believe that union is as much a human necessity as liberty is a divine gift.

To believe, not that all people are good, but that the way to make them better is to trust the whole people.

To believe that a free state should offer an asylum to the oppressed, and an example of virtue, sobriety, and fair-dealing to all nations.

To believe that for the existence and perpetuity of such a state a man should be willing to give his whole service, in property, in labor and in life.

That is Americanism; an ideal embodying itself in a people; a creed heated white-hot in the furnace of conviction and hammered into shape on the anvil of life; a vision commanding men to follow it whithersoever it may lead them. And it was the subordination of the personal self to that ideal, that creed, that vision, which gave eminence and glory to Washington and the men who stood with him.

Such was the glorious birth of our Nation,  
Our inheritance its perpetuation.



# THE SURGICAL LESSONS OF THE EUROPEAN WAR \*

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A CRITICAL review of the vast amount of surgical literature which has come into being as a result of the European War brings out the fact that there is a great deal of conflicting testimony on the part of many of the observers who have had more or less close range opportunities to study the surgical conditions of this all but Pan-European struggle. That this should be the case is not surprising when one realizes that, after nearly two years of the war, there have been close on to thirty million men actively engaged in this great carnage of the nations; and, out of this stupendous number, there are at present eighty odd thousand surgeons whose work and observations extend over a battle front of many thousands of miles and under many varying conditions. This number of surgeons represents a fair estimate of the present commissioned personnel of the medical corps of the belligerents, but does not take into consideration the large number of surgeons whose activities have been curtailed by reason of deaths, wounds and disease. Nor does it take into consideration a large number of medical and surgical men who, by reason of age and other causes, are prevented from participating except in a semi-official capacity in their home towns or cities.

It is no small wonder then that from this large number of observers there should arise varying degrees of divergent opinions with reference to the salient surgical problems which have had to be met and solved from time to time. Not until peace has been established, and the professional mind has had an opportunity to thoroughly digest all of the statistical evidence, will the real facts be shown in their true light. Until such time, we shall have to content ourselves with correlating the experiences of these many different observers who are viewing the same general subject from many different angles of observation. From this distillation of the recorded data we should be able to forecast a solution, as regards some of the disputed points, and visualize a more or less accurate interpretation of the surgical lessons of the war.

Certainly the surgery of war is not the surgery of peace, and an acceptance of this fundamental idea is necessary at the outset if we are

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\* Read before the American Surgical Association, May 9, 1916.

## SURGICAL LESSONS OF THE EUROPEAN WAR

to arrive at a correct understanding of many of the questions which confront the military surgeon in his effort to meet the sudden, and oftentimes overwhelming, demands occurring as a result of a more or less continuous traumatic epidemic incident to battle conditions. In striving to understand this situation, the civil surgeon must begin by realizing that the military surgeon, in order to fulfil his function successfully, must be a specialist in surgical adaptability and compromise. The perspective of the military surgeon is totally different from that of his civilian confrère in that it is paradoxically both broadened and narrowed. Broadened because of the necessity for making continual concessions as regards obtaining the ideal in order to secure the best general results; and, at the same time, narrowed because of the necessarily restricted application of complicated surgical procedures to the circumscribed field of general traumatic emergencies. Although the military surgeon has many other activities besides the practice of surgery, the limits of this paper prohibit a discussion of the problems in hygiene, sanitation, preventative medicine, organization and administration, all of which combine to make military practice a highly specialized branch of the healing art.

In reviewing the surgical literature of the present war, it is quite evident that all medico-military observers agree that the wounds encountered are not only totally different from the surgical experiences of civil practice, but that infection in some form is always to be found in the wounds treated in war hospitals. Disregarding the relatively few penetrating or perforating bullet wounds which do so little tissue damage that they heal spontaneously, the outstanding feature of all serious wounds in this war is the mutilating and devitalizing effect on the tissues due to large and small irregular pieces of metal, the majority of which are fragments of the high-explosive shell and hand grenade. Many of these wounds are of such a mutilating character as to be compared only to the crushing injuries of railroad practice in civil life. Invariably the serious wounds have been found to contain various foreign particles, such as bits of clothing, metal or other foreign material, which undoubtedly accounts in large measure for the universal infection. A large percentage of these war wounds have been compound fractures of long bones, involving usually a considerable loss of substance, so that the surgical problem not only had to take into consideration the treatment of wounds infected with a variety of bacterial flora, but also the development of suitable fixation apparatus in connection with the all-important after-treatment of the case.

As regards the character of the infection encountered in war

wounds, all observers agree substantially that the primary infection has been due practically to a faecal contamination. In other words, the infection in the early stages was due to organisms which normally inhabited the intestines of men and animals, such as *B. aerogenes capsulatus*, *streptococcus*, *B. proteus*, *B. coli*, *B. tetani*, and a number of spore-bearing putrefactive anaërobic bacilli, which give rise to the foul odor and all of which are to be found in faeces. A large number of carefully executed laboratory examinations, in conjunction with the clinical evidence, have brought out the fact that the soldier's clothing is practically always the source of this primary wound infection. The original source of the infecting organism is unquestionably the soil of the particular part of the country in which the trenches are dug. The soil of Belgium and northern France has undergone an intensive fertilization for many years and is saturated with the organisms enumerated above. The prolonged and intimate contact of the soldier's clothing with the trench dust and mud accounts for the conditions which make for universal wound infection in underground warfare.

The history of all war wound infections clearly shows that the character of the infection is largely a matter of the composition and condition of the soil over which, and in which, the campaign is being conducted. The dry and uncultivated arid veldts of South Africa, in which there are but few, and oftentimes no, pathogenic bacteria, was responsible for the relatively few cases of serious wound infection which obtained throughout the Boer War. Such would be the case in any other locality in which habitations were few and the general condition of the terrain unsuitable for bacterial growth; so that the study and knowledge of the bacterial content and character of the soil will be the military surgeon's future guide as regards what to expect and what to provide for in any particular campaign.

The course of wound infection in the present war may be divided into three stages: First, there is a gross infection with anaërobic spore-bearing bacilli, producing a foul-smelling scanty discharge due to the action of the bacilli on the blood clot and serum in the wound. Strep-tococci are also usually to be found in the wounds at this time, although they are not apt to be actively manifest until a later period. Secondly, the anaërobic bacilli gradually diminish over a period of about ten days and the discharge becomes more frankly purulent, although the predominant infection during this period is usually of an anaërobic character. Thirdly, there is usually an active infection with pyogenic cocci dating from two to four days after the reception of the wound.

The best way of combating the infection which has taken place

## SURGICAL LESSONS OF THE EUROPEAN WAR

has been a matter of considerable discussion from time to time; and, even at this date, there is no little dispute as to the correct method which should be adopted in order to secure the best results. Quite a large number of surgeons in this war have been slow to appreciate what has already been stated, namely, that the surgery of war is not the surgery of peace. In war surgery neither the condition of the patients themselves, nor the character of their wounds, is at all comparable with the surgical practice of peace and, in addition to this, the character of the infection is quite different from that in civil life. It must be remembered that the general condition of the patient plays a paramount part in the subsequent healing process of any wound. In the present war, the average patient who reaches a field hospital has had his vitality seriously depleted from a number of different causes. Disregarding the various degrees of traumatic shock which accompanies the reception of all wounds, the military surgeon finds he has to deal with the moderate and extreme effects of exposure, starvation, or physical exhaustion due, usually, to the fact that the patient could not be rescued for some time after being wounded. The resisting power has been greatly lowered from these causes and the patient falls a much easier victim to the ravages of infection than is the case in civil life. It has sometimes happened that certain wounded men have not been rescued until five or six days have elapsed, on account of having fallen between the lines. The exigencies of trench warfare have caused serious and oftentimes fatal delays in conducting the patient to a place where his wounds could be adequately treated. It has often been impracticable to remove the wounded, except at night, on account of attracting the enemy's fire, and every hour's transportation delay, which latter may be due to various causes, means that the ever-present infection is progressively increasing and becoming more firmly established.

This general condition of affairs is totally different from civil practice where a surgeon receives, for example, a crush wound of the thigh for treatment, which has been promptly brought in after the accident, and which is handled throughout under modern aseptic conditions. Immediate and complete attention can be given in civil hospitals to the most complicated wound and the surgeon is not hurried by the knowledge that there are probably many other seriously injured awaiting his attention. In direct contrast with this the surgery of war calls for a series of delays because of the necessarily graded attention to the wounded. Beginning with the application of a first-aid dressing in some protected spot immediately behind the trenches; then, when

opportunity offers, transportation by stretcher bearers to an advanced dressing station, located from a half to one mile in the rear, where the bandage is reinforced and supporting treatment given; on back five or six miles to a field or clearing hospital where each wound is examined, re-tagged, drainage facilitated, antiseptic dressing applied and some form of temporary, or permanent, fixation splint secured to the part. Not until a patient reaches a base hospital, usually from three to five days after being wounded, does he receive as complete surgical attention as his condition demands. This, in short, represents the routine war surgical treatment, and this general working plan has been found by experience to result in less confusion as regards the details to be carried out, and in less detriment to the general welfare of the average patient. The whole system is the result of a compromise, on the one hand, between the ideal treatment of wounds in a well-equipped civil hospital under normal conditions, and on the other hand, the oftentimes overwhelming amount of work to be performed under the very trying conditions of urgent war surgery in the field.

With these facts before us, and the testimony of numerous observers to guide us, we may endeavor to form an opinion as to the proper surgical procedures to be instituted in the wounds of war. As regards the principle of thorough drainage there is no dispute. There have been several variations from the time-honored method of wide incisions, with drainage tubes, into the depth of the wound to prevent the pocketing of pus. The variations have taken the form of either a suction apparatus applied usually to the dependent part of the wound in the hope that, when combined with continuous irrigation, the septic material will be rapidly withdrawn; or it has taken the form of wide open wound exposure to atmospheric air and sunlight. In any event, the main objects accomplished were the prompt removal of the products of infection and the creation of anaërobic conditions in the wound, and these factors alone seem to have been the first and controlling influence in limiting the spread of infection in the surgery of the present war.

There are two schools of thought as regards the use of antiseptics in the wounds, after free drainage has been established, in order to inhibit more thoroughly the growth and activity of organisms which may remain in the wound. One school, headed by Sir Almroth Wright, maintains that the use of antiseptics is not only unscientific but actually harmful in the great majority of cases. This school teaches that the physiological indications in all infected wounds call for rendering the lymph incoagulable, repressing leucocytic emigration and increasing the flow of lymph from the walls of the wound, thereby

## SURGICAL LESSONS OF THE EUROPEAN WAR

mechanically carrying away harmful organisms and necrotic material. This lymphogogic application consists in the use of a hypertonic salt solution (5 per cent. common salt and  $\frac{1}{2}$  per cent. sodium citrate) either as a wet dressing or as a continuous irrigation. The other, or antiseptic school, of which Alexis Carrel and Sir Berkeley Moynihan are sponsors, states emphatically that the antiseptic treatment of wounds not only has a distinct, important and continuous rôle in war surgery, but that it offers the only hope of aborting an infective process in the earlier stages of wound infection.

There is a large mass of testimony on both sides. The reports of those who advocate the hypertonic salt treatment are practically uniform and are not difficult of interpretation. On the other hand, the surgical war literature for the past twenty months has been inundated with reports setting forth the value of this or that antiseptic treatment. The entire list of all known antiseptics has been reported upon and, while many of these were quickly discarded, a number remained in active use and afford a basis of comparison with the hypertonic salt method. Quite a number of unbiased investigators have had ample opportunity to test the claims of each school, and the consensus of their published opinions indicate that there is a distinct field of usefulness for both methods, although the great majority of these investigations show a decided leaning towards viewing the antiseptic method as being, in the long run, the more practical of the two. A number of these reports have a tendency to emphasize the value of surgical common-sense in selecting the line of treatment to pursue in a particular case, and that the treatment must be varied according to conditions.

It would seem that the Dakin fluid is the antiseptic of choice among the great majority of those who, at one time or another, have had recourse to the antiseptic method of treatment. This antiseptic fluid, which is a 0.5 per cent. concentration of sodium hypochlorite, is made by dissolving 140 grammes of dry carbonate of soda in ten litres of sterile water. To this is added 200 grammes of chlorinated lime and the mixture is shaken well. After a half hour the supernatant clear fluid is siphoned off into another bottle, through a cotton plug or filter paper, and then 40 grammes of boric acid are added to the clear filtrate. This solution is neutral to litmus, is non-irritating and is the proper strength for wet dressings and irrigations. The solution should be made fresh every three or four days and the dry stock ingredients should be kept in covered receptacles. It is a significant fact that the Dakin fluid is preferred above all other antiseptics by the great ma-

jority of medical officers who are bearing the heat and burden of the day at or near the front, while other methods of treatment receive support on theoretical grounds from those who are mostly associated with a long-distance view of the war situation.

There can be no doubt as to the value of the early use of the Dakin fluid in the large, lacerated and infected wounds of the present war, and from the many published observations, covering a wide range of usefulness in all character of wounds, it would seem as if there were hardly a dissenting voice in acclaiming it the ideal antiseptic treatment. Substantial and convincing data are not wanting to show that, if used within the first ten hours after the wound has been inflicted, it will often sterilize the wound in a comparatively short time, depending, of course, on the size and character of the wound and the general nature of the infection. After the wound has been thoroughly cleaned of all foreign material and the sides of the wound made smooth by trimming away all ragged and necrotic tissue, a number of small fenestrated rubber tubes are introduced into the depth of the wound and the latter lightly packed with sterile gauze. The number of the small tubes to be introduced will depend upon the nature of the wound as regards the direction and number of the diverticula. The object to be attained is that, when the antiseptic is injected into the tubes, which latter extend beyond the outer dressings, it will reach all parts of the wound. The equitable distribution of the antiseptic throughout the wound is somewhat facilitated by having the ends of the tubes covered for several inches with a thick material, such as rough toweling, so that when the antiseptic is injected it will not spurt into the wound but will gradually pass through the toweling which covers the fenestra and the end of the tube. A small quantity of the antiseptic is injected into the tubes every one or two hours so that the gauze in the wound is kept continuously saturated with the solution, or the tubes may be coupled up with a Murphy drip apparatus. This method has proven very satisfactory as a continued treatment on hospital trains when, on account of the exigencies of the war situation, the wounded have had to be transferred from field and clearing hospitals towards the more distant rear. Oft-times the delay *en route* has been from three to five days, and this method of treatment admits of continuing the use of the antiseptic while travelling with a minimum disturbance of the dressings and wound.

In the base hospitals all dressings are removed every morning and the quantity of the antiseptic is reduced as the wound clears up. A prominent feature of the Dakin fluid, which is emphasized by many, is its remarkable property of dissolving or detaching devitalized or

## SURGICAL LESSONS OF THE EUROPEAN WAR

necrotic material in the wound. This, of course, is extremely valuable when an anaërobic infection predominates as the anaërobies undoubtedly thrive best on necrotic material. The hypertonic salt solution has also proven of great value in detaching sloughs and devitalized tissue, although its continued use is liable to produce pain and an exuberant growth of granulations. The use of the hypertonic salt solution causes a great outpouring of lymph, which in itself is depleting, so that it would be impracticable to apply it to a large group of cases whose vitality and resistance are already considerably lowered.

Summing up all the available evidence, it would seem that one of the prominent surgical lessons of this war is the early, and more or less continued, use of a potent and practical antiseptic with the idea of aborting, if possible, the infective process before it has gained an ascendancy over the adjacent traumatized tissue. When it is apparent, from the local and constitutional condition of the patient, that the infection is well under control, the hypertonic salt solution may be used with satisfaction in selective cases, particularly if there is evidence of continued sloughing in the wound. Experimental work is still in progress and there is hope that further developments will disclose an even more suitable antiseptic than the Dakin fluid; but, until reports along this line are forthcoming, there is little doubt but that this antiseptic fluid has given the most decidedly satisfactory results to both patients and surgeons. Moynihan has voiced the sentiments of a large number of practical surgeons in this war by saying: "Every hour that elapses increases the extent, the penetration, and the virulence of the infection. I think, therefore, that the first attack made by a surgeon on a wound received in battle should be by an antiseptic, and the most powerful that it is proper to use. I do not think that Wright's method is applicable, in the worst cases at least. For the condition of the soldiers who have received severe wounds is one of exhaustion, with lowered blood-pressure, cold extremities, feeble pulse, and marked pallor. A few of these patients need infusion before any remedial measures can be attempted, and very many suffer from shock in greater or less degree."

As regards the first-aid packet carried by each soldier, very little information is to be derived from current war literature in connection with a determination of its real value in any of its present forms. The small first-aid packet, with its familiar contents, was launched many years ago when the low velocity bullet wound was by far the commonest war wound. In this wound there was comparatively very little tissue damage, even when compact bone was struck. The advent of



the high-velocity sharp-pointed bullet has entirely changed the aspect of these wounds, particularly since practically all bullet wounds in this war are inflicted at very close range. The average bullet wound of this war shows a progressively increasing destruction of tissue in the path of the projectile, and the secondary missile effect of splintered bone is oftentimes appalling, resulting usually in large explosive wounds of exit with considerable loss of substance. As a consequence, the small pads of gauze in the average first-aid packet afford but little protection to the extensive wound. In addition to this there is no doubt that the majority of present war wounds are due to fragments of the high-explosive shell and hand-grenade. These wounds are usually large, lacerated, multiple and exceedingly destructive so that the small first-aid packet is of little or no use.

When a soldier has been struck down in a trench, unless the wound happens to be in the head, hand or foot, no idea of the extent or character of the wound can be ascertained at the time on account of the clothes which usually cover the wounded part. It is not only impracticable to remove the clothing at this time, but it is still more futile to attempt the application of any first-aid dressing until it can be applied directly on and over the wound or wounds. The soldier lies where he has fallen, usually in the mud or dirt, until a lull in the engagement permits his comrades to remove him to a place of safety, usually a hundred yards or more in the rear. A considerable lapse of time may transpire before the wounded man can be brought to the spot where an intelligent application of the first-aid packet can be made. In the meantime the wound or wounds have become more or less contaminated by the ever-present infection in the mud, dirt, or clothing, which is caked in the wound by the blood. Hence it is that the small first-aid packet has been of little or no value in the primary treatment of the serious wounds of the present trench warfare. The reason that these packets are not discarded is probably due to the fact that they take up but very little space, and doubtless there is a sufficient number of small superficial wounds to warrant retaining them in the soldier's outfit. The larger and more pretentious first-aid dressings are the ones in common use and are regarded as being the only ones capable of preventing further contamination of the wound.

When the clothes over the wound have been removed at the nearest spot where the first-aid dressing can be seriously applied, iodine, poured on the wound and painted on the surrounding skin, has undoubtedly been a valuable adjunct for the reason that the wound contains a variable amount of gross infective material and it would be folly to

## SURGICAL LESSONS OF THE EUROPEAN WAR

seal it up with a first-aid dressing without some effort at disinfection if it be possible to apply it. This is the critical time in the history of every wound. If the wounded man can be promptly removed to an advanced dressing station, and from there promptly transported to a field or clearing hospital, his chances will be greatly improved. It has too often happened, however, that many and serious delays have occurred before a wound has received anything like adequate surgical treatment, and, as a result, infection has usually been widespread by the time the operating surgeon takes charge of the wound.

As regards the operative procedures, there has been a large number of favorable reports on the total excision of wounds. This practice, of course, can only be carried out thoroughly in comparatively small wounds and in certain parts of the body. The same idea applied to the large lacerated and contused wounds means as complete removal of the walls of the wound as is practicable from an anatomical point of view. There can be no doubt that the large and small irregular pieces of metal, which plow their way through the tissues at a high velocity, cause a considerable amount of tissue devitalization in the path of the projectile, and hence the principle of total excision of the wound is surgically sound and eminently satisfactory for the reason that it removes the devitalized walls of the wound which would sooner or later slough and prolong the infective process. Once the walls of the wound have been made as smooth as practicable by the removal of all overhanging edges and the torn pieces of fascia and muscle, not only is drainage complete, but the wound itself is left in the best possible condition to combat the presence of infection. There is also considerable favorable comment in many reports as to the value of keeping septic cases in the open air and sunlight. In many instances it has seemed to have been the deciding factor in increasing the general resistance to the point where the septic condition could be effectually controlled. Even in cold weather, the removal of patients to verandas and porches has been attended by the most satisfactory results.

As regards penetrating or perforating wounds of the head or abdomen, they represent, along with hemorrhage in any part of the body, the class of cases which call for the urgent field surgery. In the brain injuries, a large percentage are moribund on admission to a field hospital and die within a few hours. All tangential and other fractures are operated upon as expeditiously as possible by trephining and the elevation of fragments. If possible the patients are kept for a number of days before transportation to the rear for obvious reasons. There are no complete statistics available but on the whole the results are

encouraging in recent cases, although the mortality is still high as compared to head injuries treated in civil hospitals. The use of the probe is strongly deprecated by many, and the projectile, unless readily accessible, has been left for removal later, after the wound has healed.

In the penetrating and perforating injuries of the abdomen, the field surgical experiences of the South African War seemed to prove conclusively that opium, starvation and rest in the Fowler position yielded better results than treatment by operation. It would seem, from reports, that the contrary is the case in the present war. Where it has been possible for the patient to receive prompt attention the results from operative treatment have been most encouraging in improving the statistics as compared with the expectant line of treatment. Every effort is made to secure these cases for operation promptly, otherwise surgical judgment must be exercised as to the class of cases in which to operate. As Mayo-Robson says: "A clean bullet wound through the abdomen, with small wounds of entry and exit, and without evidences of internal hemorrhage or extravasation, may, if favorably situated, be treated expectantly; whereas a bullet wound with large openings of entry and exit, or with signs of internal hemorrhage or extravasation, and with the absence of liver dulness, should be operated on as soon as possible, if seen early, and the general condition is favorable. As nearly all shrapnel, shell and bomb wounds are septic and produce great visceral injury, operation will give a better chance of success than expectant treatment if the patient is in a fit condition to bear it and the case is seen early. If the case is seen late and peritonitis has already set in, a small incision above the pubes, large enough for the insertion of a drainage tube down to the bottom of the pelvis, and the Fowler position, will give the patient a chance for recovery."

In a recent personal communication, dated April 7, 1916, from Dr. Joseph A. Blake, who is Surgeon-in-Chief of a large surgical base hospital in France, the following statement is made: "I have seen remarkably good work in the first line dressing stations in the English Army situated even in front of the big guns. In one ward of twenty beds established in a laundry, I saw eight cases of intestinal resection for multiple wounds of the intestines getting well, and I firmly believe in an early intervention." As regards cerebral injuries Dr. Blake further states as follows: "One thing I should lay special stress upon is the wearing of the metal helmet. Judging from the wounded coming from Verdun now, there is a much larger percentage of head wounds. Nearly all of these men attributed their escape from death to the fact that they were wearing the helmet; and a very large proportion of

## SURGICAL LESSONS OF THE EUROPEAN WAR

these wounds simply involve the cranium, and the dura is not lacerated."

Another important lesson of the present war, as indicated in a number of reports, is the firm conviction in the minds of all competent observers that the organization for field work must be so perfected that the wounded shall receive complete surgical attention within the shortest possible time. As Carrel has rightly said: "The future of the wounded depends upon the rapidity of transportation and the possibility of treating the wounded as soon as possible." This lesson is finding expression in the establishment of small but well-equipped base hospitals in carefully selected protected spots within a comparatively short distance of the trenches, usually from three to six hours' ride by motor ambulance, and it has been demonstrated that these easily accessible surgical centres have materially improved the statistics of general field surgery. The development of the automobile combination field and base hospital, which contemplates giving complete surgical attention within two or three miles of the front, is a step in the right direction to obviate unnecessary delays in transportation on the principle that if the mountain cannot come to Mohammed then Mohammed must go to the mountain. The automobile has played a most conspicuous part in the present war, and in no other branch of the service has its usefulness been displayed to better advantage than in the medical department where prompt transportation of the wounded is of paramount importance.

Probably the most obvious surgical lesson of the war is the prophylactic use of antitetanic serum, subcutaneously administered, as soon as practicable after the soldier has been wounded. If possible it is given at a field dressing station and this fact recorded on the wound tag with which every patient is provided. At a field hospital the wound tag is carefully examined to ascertain whether or not the antitoxin has been given and if there is any doubt a dose is immediately administered. In the early months of the war tetanus was a rather common sequel in the seriously wounded cases. Since the routine use of the antitoxin for a year and a half there have been practically no cases of tetanus treated in France or England. In contrast to the success attending the prophylactic use of this antitoxin there have been numerous reports recording the failure of other sera or vaccines as a means of combating certain other wound infections. The one exception to this is several reports which give very encouraging results following the early administration of antistreptococcic serum in some of the badly infected cases. It would seem that the prophylactic use of these measures has a much more potent effect than any curative properties they may possess. Sir Watson Cheyne has suggested that bacteriologists have a great op-

portunity at the present time, and that they may be profitably employed in raising the immunity of new recruits in training camps against all the ordinary bacteria which occur in wounds received in war time.

The recognition of the great value of a surgical dental department in every base hospital is certainly one of the prominent lessons of the war. In conjunction with the regular surgical services, the dental surgeon has proved himself indispensable as regards the treatment of all wounds involving the upper or lower jaw. Time does not permit of entering into a discussion of the various plastic principles which govern the combined surgical and dental treatment of these very distressing wounds. Accurate descriptions of the various steps in the technic have appeared in print from time to time, and these reports would seem to indicate that every case, however badly mutilated, can not only be greatly benefited, but, in many instances, a practically perfect result can be obtained.

There is yet another valuable department which is being added to every base hospital, and which is now regarded by many as one of the essential features in the organization for treating the seriously wounded. This department has to do with the making of all splints and special apparatus in connection with fractures of all kinds. While various well-known methods and splints have been used successfully in the treatment of many cases, yet many of the complicated compound fractures have had to be treated by the use of apparatus specially devised to suit the needs of the individual case. All of these cases, on account of the infection which is invariably present, have to be dressed at intervals and any apparatus which is used has to take into consideration the all-important after-treatment of the case. The surgeon who has charge of the case indicates to the head of the special apparatus department the general character of the splint he desires to use on any particular case. This may be done before operation, or even at the time of operation, when certain measurements can be made and the splint delivered in a remarkably short space of time if the department is well organized and equipped for this special work.

On account of the fact that the surgeons in the field rarely have an opportunity of seeing the end results following any particular treatment they may have started, and whether or not their work is successful, Sir Almroth Wright has suggested the formation of boards of medical officers who would meet from time to time at various points along the line and not only correlate the experiences of the field and base hospital surgeons, as regards the surgical lessons of the war, but who would be able to promulgate much useful information as to the most

## SURGICAL LESSONS OF THE EUROPEAN WAR

efficient manner and means of treatment. It is true that the advantages or disadvantages of certain methods filter slowly, and in the course of time become more or less common knowledge, but it is also true that during this period of slow dissemination of knowledge the wounded are the ones who suffer, and the country is not getting the best results from its medical department because of a lack of system in passing along profitable information. As it stands to-day, many of the valuable lessons will not be recognized as such until after the war is over and the opportunities for practicable application long passed.

I cannot close this paper without giving expression to the fact that any one who has had an opportunity of observing this war at close range is imbued with the reality that the general after-effects will be the most mutilating and devastating that the world has ever known. When this crimson chapter in European history is closed, and those of the present generation who are left strive to orient themselves amid the vast display of economic and material ruin, they will be confronted on every hand by the presence of the lame, the halt and the blind, whose pathetic existence will but continuously echo the world's disgust for war. Despair and misery will be their heritage for many years to come, and so far-reaching will be the pitiable consequences of this titanic effort to destroy the tablets of civilization that progress will wear the ghastly scar for ages.

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# LOCALIZATION AND EXTRACTION OF PROJECTILES AND SHELL FRAGMENTS\*

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THERE have been great differences of opinion expressed by military surgeons concerning the advisability of extracting or leaving projectiles or shell fragments either before or after they are healed in the tissues. On the theory that these foreign bodies are a source of danger to the host from the possibility of infection, one group maintains that they should always be removed, while another holds that extractions should be performed only in the face of very definite indications. From the general principles of surgery, it appears far more rational to support the latter view, and, accordingly, we may formulate the definite indications for extraction as follows:

1. Instances where the projectile or fragment forms a focus of supuration which will probably continue until either the fragment is removed or until it is discharged spontaneously from a fistula.
2. Instances where the foreign body is causing pain. This may be situated either in the muscles, near bones or nerves, in tendons or even superficially. Not infrequently the pain may be due to the cicatrix surrounding the fragment rather than to the fragment itself.
3. Instances where the wounds of entrance or exit have healed, leaving the projectile in the tissues surrounded by a small abscess or focus of infection encapsulated from the surrounding tissues.
4. Any interference with the function of the tissues or organs forms a rational indication for a removal of the offending foreign body.
5. Instances where the presence of the foreign body may influence the mental condition of a patient to a degree which justifies its removal.
6. Another group of cases which are of great importance in military surgery belong to the malingering type, that is to say, wounded who claim that small shell fragments or projectiles are painful in order to avoid the responsibility of further military service. In cases of this group, it is often difficult or impossible for the surgeon to determine the truthfulness or falsity of the patient's statement. I have seen repeatedly cases where I was convinced that the pain would cease on the day of

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the declaration of peace. Such instances, however, require extraction in order to restore the wounded man to active service.

7. Cases where a lead projectile may give rise to lead poisoning. There have been, apparently, a few well authenticated cases of this type.

8. When cases are brought in fresh from the front and operations are performed for infections, better drainage, removal of loose bone fragments in compound fractures, etc., the projectiles should be removed if possible.

In contradistinction to these definite indications for operation, there are certain contra-indications which we perhaps too often forget in the rush or enthusiasm of a military hospital. These may be briefly summarized as follows:

1. No operation should be performed which does more injury to the tissues than the presence of the foreign body.

2. The operations should not be performed in clean cases where there is not a reasonable expectation of aseptic healing or a great probability of finding the projectile.

With definite indications and contra-indications for operative work of this character before us, it may be well to consider for a moment the current methods of localization with particular reference to those that we found useful in Hôpital 32 bis Château de Passy (Fondation Fitzgerald).

*Radiography as a Localizing Method.*—The use of X-ray plates may be dismissed with a word, for anyone who has had experience with this method realizes that ordinary radiographs even when taken in two or more directions yield, from the topographical and localizing stand-point, insufficient data upon which to base a well planned operation. The percentage of failures in removing the projectiles by their use is very high. A number of cases were sent to us which had been operated on two, three, or four times unsuccessfully where plates had been the sole localizing aid of the operator. On the other hand, plates are of great value as an aid in determining the presence or absence of small shell fragments which might be overlooked with the fluoroscope.

I have had no personal experience with any methods like the Mackenzie-Davidson, where the depth of the foreign body is determined from known points on the skin by calculating the distance from shadows of the projectile made by double exposures on the same plate. I have been told, however, by those who have employed this technic, that it is difficult to do the extractions with the data furnished, owing to the possibility of large errors of computation due in part to the elasticity of the skin.

## LOCALIZATION AND EXTRACTION OF PROJECTILES

*Operations Directly Under the Fluoroscopic Screen.*—We performed some operations with this method of localization, but abandoned it promptly, owing to the fact that it is open to two serious objections, namely: The difficulty of maintaining asepsis in the dark which, however, is not an insuperable obstacle, inasmuch as a surgical technic can be devised which will practically eliminate the danger of infection. The second drawback, however, is one based on the fundamental principle that the screen reveals clearly the foreign body that is to be removed and only vaguely the tissues which have to be conserved. It likewise does not differentiate in the soft parts between structures of importance and those which are negligible. By this method accurate surgery is impossible; the tissues have to be more or less torn and lacerated, so that injuries of the nerves, blood-vessels, and other structures may easily occur, owing to their relative invisibility. This, of course, is not the case in open operation in a good light where the structures are divided under the eye of the operator. Furthermore, screen operations cannot be practised in regions of the body where there are structures of great importance, like the neck, chest, or abdomen. The method is limited at best to operations on the extremities and to parts like the forearm or leg where tissues are readily separated in a longitudinal direction. It is quite obvious, then, that this localizing technic cannot survive in view of other more practical and accurate systems which have been developed during this war, even when the latest improvements in the method are employed, where the operations are performed under a red light and the fluoroscopic screen is used intermittently to control the search for the foreign body. It is evident that the difficulties of operating in the fluoroscopic room and the obstacle of providing adequate illumination for major procedures are really insurmountable for the ordinary military hospital.

*The Ring Compass.*—This well-known method provides for the operator localizing data in the form of marks on the skin at the level of the foreign body representing the ends of two or more imaginary diagonals that pass through the projectile. These diagonals, as they are usually taken, run at right angles to each other. To obtain these marks compasses shaped something like a pelvimeter are employed, which have on their ends small rings about 15 mm. in diameter (Fig. 1). The patient is placed under the fluoroscope and the projectile centred by diaphragm to eliminate the oblique rays when the compasses are applied, so that the foreign body lies exactly in the centre of the two rings, one of which is on either side of the part of the body in which the foreign body lies. By means of a skin pencil or a special marker, signs are made

in the middle of the rings which are held carefully in position during the removal of the fluoroscope. The part containing the projectile is then moved through an angle of 90 degrees and the process repeated. In this way, four points are obtained on the skin which represent the ends of intersecting lines passing through the projectile. These serve the operator as his localizing guides, but the exact depth of the foreign body is still a mere matter of approximate conjecture.

*The Irvin Profondometer.*—During our work in improving the

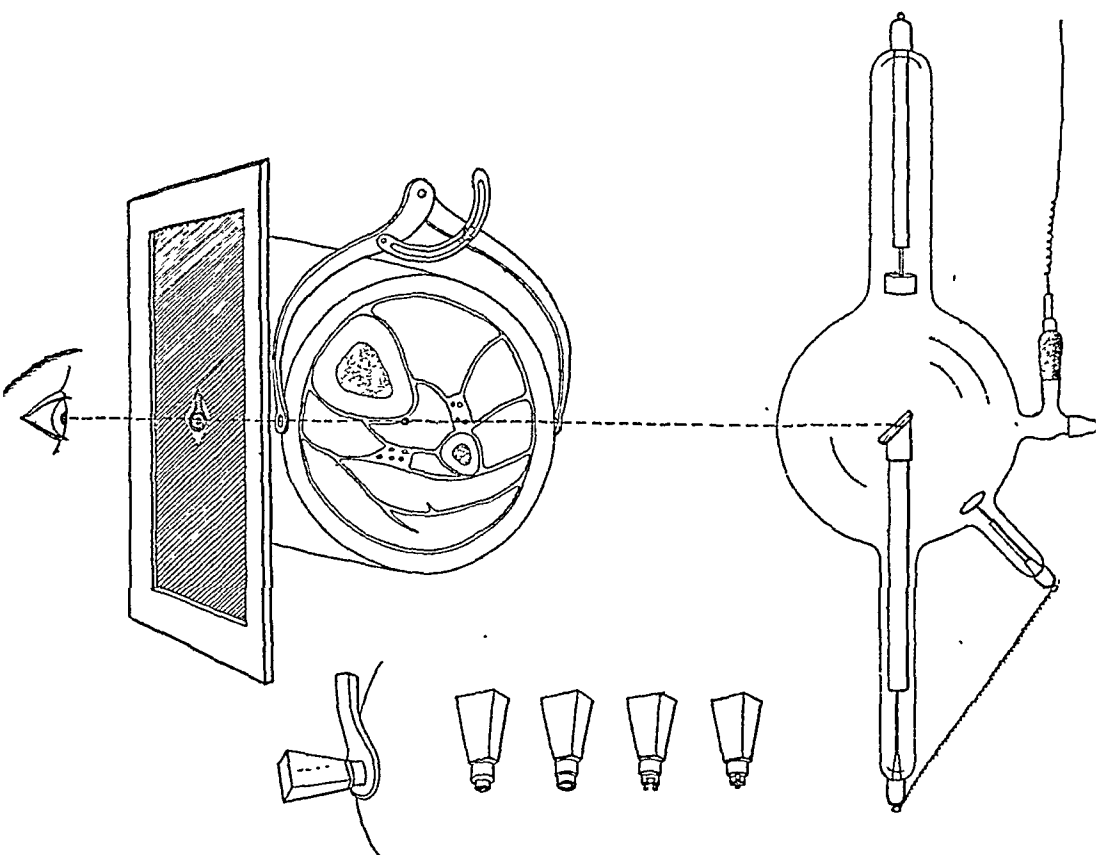


FIG. 1.—Diagram showing the use of the fluoroscope and the ring compass to obtain the diagonals passing through the projectile and the stamps to mark them on the skin.

methods of localization, my assistant, Dr. John Irvin, suggested the use of a very simple and effective profundometer which we find on searching the literature is based on a principle that has been previously used for determining the position of foreign bodies in the cranium. The old method consisted in localizing by means of a compass and then placing a band of supple metal around the head and transferring the marks obtained by the compass to the band. This was slipped off the head and placed upon a piece of paper, where a tracing was made of its outline together with the position of the compass points. The intersection

## LOCALIZATION AND EXTRACTION OF PROJECTILES

of the lines connecting the corresponding points gave the position of the foreign body. As will be seen readily, this method was not applicable to any other part of the body than the head, from which the band of metal could be removed without distorting its form. A similar improved profundometer was employed by Warluzel and Jolant and later modified by Tuffier, who used the flexible band of metal with the addition of a hinge to prevent distortion as it is removed from the body. The metallic band in Tuffier's profundometer is pierced by holes, which are employed to determine the points of emergence and exit of the rays passing through the projectile. These are marked and, after the profundometer is removed, wires or small rods are placed in these particular holes, giving at their point of intersection the position of the projectile.

The profundometer consists of a band of malleable metal, such as tin, lead or aluminum, with a hinge in the middle. This permits the localizer to be placed in any part of the body, moulded carefully, and to be removed without distortion. They are made in various sizes, so that they may adapt themselves to a finger as well as a chest, pelvis or abdomen, the proportion of the width to the length from one end to the hinge being roughly one to fifteen. They cost but a few cents and can be made by anyone with a little mechanical ability. The idea involved in this method of localization is to obtain on paper a life-size cross-section of the part of the body at the level of the projectile into which the important anatomical structures can be sketched and which has the position of the foreign body indicated accurately with reference to the skin surface. From these graphic tracings, the operation can be planned and the incision selected. Such a tracing also serves as a control for measurements during the operation.

In making the localization, the patient is placed under the screen and the compass method employed in the ordinary way. We have multiplied the number of observations, usually taking four and sometimes six or eight, in order to increase its accuracy. In making the marks on the skin in the compass rings, an ordinary rubber stamp pad is used with small stamps whittled out of wood to give distinguishing characteristic marks like dots, crosses, diamonds, squares, etc., which are not easily confused after the compass localization is complete (Fig. 1). Small rubber stamps with numbers or letters may also be employed as the indicators. In any case, the stamps, either rubber or wooden, should be short in order to facilitate placing the marks in the ring situated at the dependent part of the body just above the X-ray table. It is, of course, obvious that the two marks made at each compass observation should correspond. In case of doubt from the blurring of the marks, the

blurred observation is discarded and only the diagonals that can be identified with certainty are placed upon the chart. The patient is placed parallel to the surface of table and elevated by blocks when lying down, some two or three inches above it, to facilitate the application of the compasses and the marks on the lower side. In cases that are ambulatory, localizations of the chest and abdomen can be made most conveniently in the erect posture.

After the skin marks are obtained, the function of the profundometer is to give a contour line of the skin at the level of the foreign body, making it possible to convert the imaginary diagonals represented

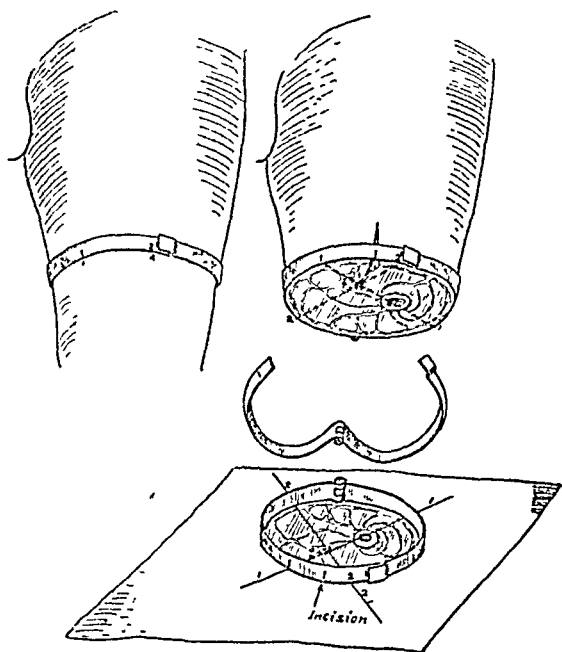


FIG. 2.—Diagram showing how the profundometer is employed to make the cross-section charts and its use in indicating the exact position of the incision.

by the compass marks into real diagonals, thus localizing accurately the foreign body in the horizontal cross-section with reference to the skin surface. This is done by placing a profundometer of suitable size (Fig. 2) with the hinge at the midline behind at the level of the part where the skin marks are found, as these always lie in a horizontal plane. This is very carefully moulded to the contour of the body and a mark is made at the point where the branches of the instrument overlap. The marks on the skin are then accurately transferred to the profundometer and the latter is carefully removed and placed upon a sheet of paper. The outline representing the skin contour is then traced together with the position of the skin marks. The profundometer is

## LOCALIZATION AND EXTRACTION OF PROJECTILES

thereupon removed from the paper and the corresponding points obtained by the compass are converted into real diagonals by a ruler, so that we have the exact position of the projectile indicated at the point where the lines intersect. Finally, the important anatomical structures can be sketched into the cross-section, a procedure which is greatly facilitated by the aid of a good cross-section anatomy like that of Eyclesheimer and Shoemaker, for example. It is now possible with these data to plan the operation and select the incision with reference to surgical and anatomical considerations, which is then marked on the tracing. By means of the profundometer, the position of the incision can be transferred to the skin surface of the body by first marking it from the tracing on the instrument and then replacing the latter on the body in its original position and making a corresponding mark on the skin. The tracing may then be used to obtain exact measurements from the incision to the projectile. The various stages of the application of the profundometer and the method of obtaining the tracing are shown in Fig. 2. It is important to remember in obtaining cross-sections of large regions of the body, like the chest or abdomen, where there may be some distortion of the profundometer from the spring in the metal which might lead to a slight error, it is well to control the anteroposterior and lateral diameters of the section under examination. This is done most easily by checking up these dimensions as the profundometer is placed on the paper. The measurements are most readily taken by the compasses which can be fixed by a set-screw shown in Fig. 1, which I have added to the original instrument for this purpose.

There are several parts of the body where the localization has to be modified. The way I have met these problems will be discussed with the cases in which they occurred.

*The Sutton Localizer.*—This is an excellent method which is very easily employed and has relatively few limitations for localizations in the extremities. It cannot, however, be used for projectiles in the neck, chest, or abdomen. The method as originally devised by Sutton consists in the introduction of a special cannula or trochar under the skin by the aid of the fluoroscope. The cannula is employed to leave a fine piano wire with a crochet end lying adjacent to the foreign body to serve as an operative guide.

At our hospital the following technic is employed: The general position of the projectile is determined by means of radioscopy or radiography and the profundometer to give the line of incision. The field of operation is disinfected with iodine and covered with sterile towels. The operator in sterile rubber gloves injects the skin and path of the

cannula with novocaine. The skin is perforated with the pointed trochar which is immediately replaced by the blunt obturator. At this point the hands of the operator are covered with a sterile towel and the fluoroscope employed to pass the cannula under direct vision down on to the projectile which is touched and moved by it. Should vessels or nerves of any size be encountered, they are pushed aside and not perforated by the blunt end of the obturator. As soon as the projectile or shell fragment is touched, the light is turned on, the sterile towels removed, and the obturator withdrawn from the trochar and replaced by a very fine steel wire with a crochet end, so that on the withdrawal of the trochar this fine wire is left anchored in the tissues at the exact point of the fragment. The patient is then transported to the operating room and the operation performed with this fine wire serving as a guide. This last stage of the method, however, in our experience was open to certain objections, the principal one being the fact that the wire is too fine to be felt easily and is too small to be seen with any degree of distinctness, especially when the field of operation is stained with blood. I have accordingly modified the method by substituting for the fine wire an obturator, which just fits the trochar, armed with a small harpoon (Fig. 3) at the end. This opens after it leaves the trochar and has the double advantage of not only giving a firmer fixation in the tissues, but also is thick enough to be felt and seen easily during the operation. This consists simply of a thorough infiltration with novocaine, after which the skin is incised and the harpoon followed down to the foreign body. The method of inserting the Sutton localizer together with the harpoon is shown in Fig. 3. For most extractions in the extremities this method is very useful, although we have never employed it alone, but always in combination with the profundometer, which gives the operator exact data concerning the position of the projectile and allows him to insert the harpoon at the point of the best incision selected from anatomical considerations. It cannot be employed in the chest or abdomen or in the neck for fear of injuring important structures.

*The Vibrating Magnet of Bergonié.*—Another popular localizing method in France at present is that of the vibrating magnet of Bergonié (Fig. 4). The principle on which this magnet operates is well known; it uses an alternating current which is interrupted several hundred times a minute and causes magnetizable projectiles to dance in the tissues. While the method is excellent for shell fragments or for the chemise of German balls, it does not exert any influence upon copper or lead, or other substances which are not magnetizable. This makes it useless in searching for shrapnel balls, for the lead core of balls which

## LOCALIZATION AND EXTRACTION OF PROJECTILES

have lost their jackets, or for the copper French balls. It furthermore is also useless even for magnetizable balls or shell fragments situated in bone or covered by dense fibrous tissues which do not transmit the vibrations or do not allow fragments to move.

In its accuracy, it does not compare with the use of the profundometer as a means of localization, but it is particularly helpful in cases fresh from the front, which have either fractures or infections that sometimes render the manipulations necessary in the profundometer

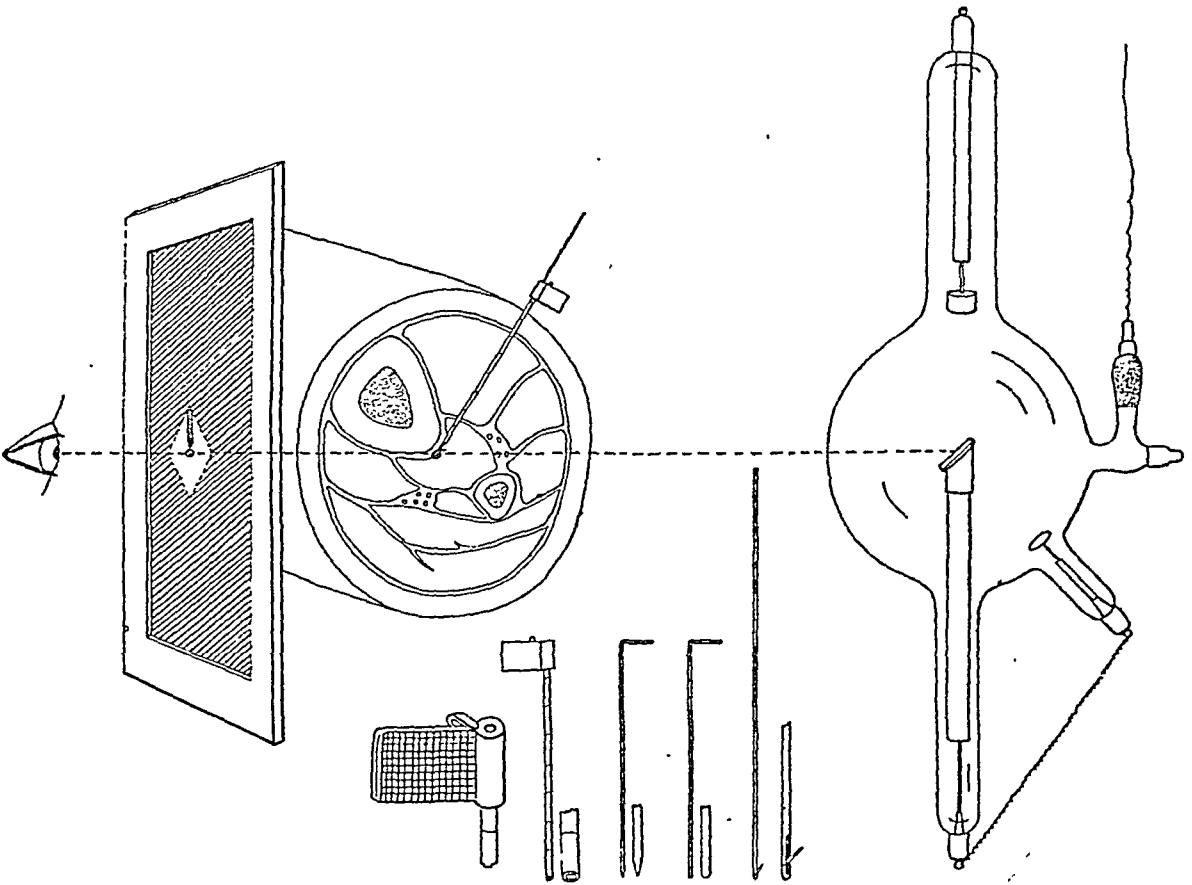


FIG. 3.—Diagram showing the Sutton cannula and trochar and the harpoon, as well as the way in which they are used.

method too painful for the patient to bear and where operations are often necessary to remove bone fragments or facilitate drainage. The percentage of extractions is much higher during these operations if the magnet can be employed.

Unfortunately, it is only possible to use it with the alternating current. In our hospital where we were supplied with a direct current, the transformation of the latter by a commutator made the resulting alternating current too weak to operate the magnet successfully.

The consideration of each one of these methods of localization shows



that they all have their drawbacks and that no one is in itself perfect. In the frequent discussions of the relative superiority of one method over another, we have apparently lost sight of the fact that the ideal procedure is a combination of several methods by which the errors of one may be corrected by another. While one method may be adapted for one part of the body, the other may be either useless or dangerous at this point. The most accurate methods, furthermore, require manipulations which are not readily borne by those suffering from recent gunshot wounds. These facts are well illustrated in some of the succeeding cases.

In general, the procedure of localization in Hôpital 32 bis has been as follows:

(1) Radiography for record and the determination of the presence or absence of very small fragments.

(2) Compass localization.

(3) The use of the profundometer for the determination of the depth of the projectile or fragment from the skin incision as well as its relation to important anatomical structures.

(4) The use of the Sutton localizer with the harpoon guide in suitable cases.

(5) An effort was made to employ the Bergonié magnet in recent cases, but this frequently failed from the lack of a current of sufficient strength to operate it effectively. In many instances the shell fragments or projectiles were found in course of the routine operations by digital search alone, aided by simple radiographs.

With these combined methods of localization, we have been able to obtain an astonishing accuracy and to remove according to the indications laid down above every shell fragment or projectile which it seemed desirable to extract, with a minimum of trauma to the tissues and a maximum of safety to the patient. In fact, with the methods outlined above, the extractions became in the majority of cases simple minor operations, only those in the chest, abdomen, or neck being at all formidable. At least 80 per cent. of the extractions were done with local anæsthesia. In the following cases, which are arranged first by methods and then by the regions of the body, the adaptability of the combined methods to locate foreign bodies anywhere is clearly shown.

CASE I.—Admitted June 19, 1915, with the diagnosis of foreign body in the knee-joint.

Wounded March 10 by shrapnel. Well-healed wound of entrance on the internal aspect of left thigh  $4\frac{1}{2}$  cm. above knee-joint. over the internal hamstrings. No wound of exit. There is fluid

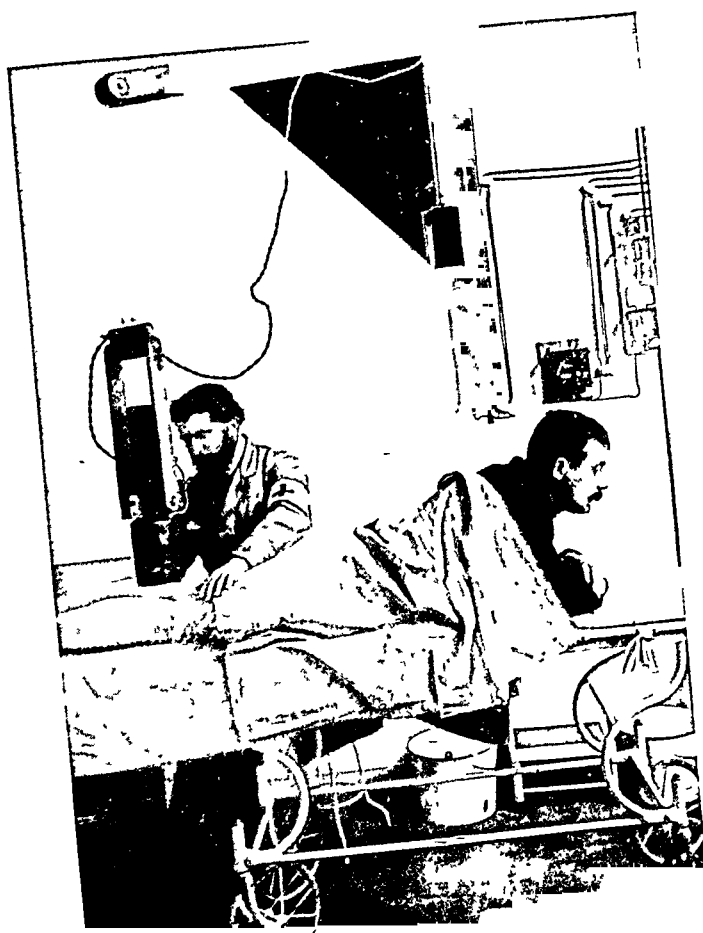


FIG. 4.—The vibrating magnet of Bergonié.



## LOCALIZATION AND EXTRACTION OF PROJECTILES

in knee-joint; floating patella. All motions of the joint are painful, but are not limited. No locking in the joint. The radiograph shows a shrapnel ball in the external condyle close to the intercondyloid notch and the joint surface. Localization by the compass indicates that the ball is about 2.8 cm. from the lateral and 1 cm. from the posterior margin of the external condyle just adjacent to the intercondyloid notch and the joint surface. The position of the ball is well shown in the two tracings of the knee made by the fluoroscope (Figs. 5 and 6).

*Operation* (August 12).—Incision over the lateral aspect of external condyle anterior to biceps tendon. Approach was down-

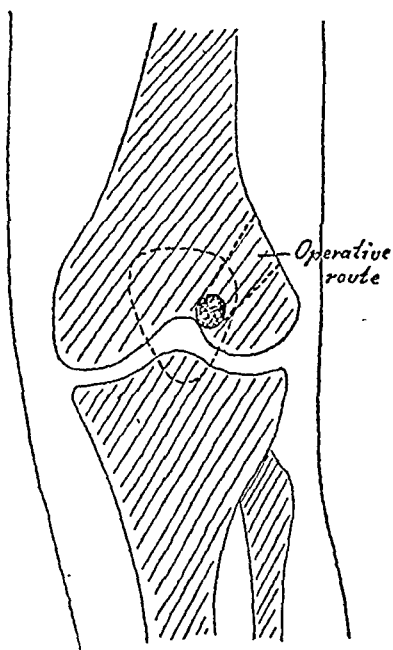


FIG. 5.—X-ray tracing of Case I (anteroposterior view).

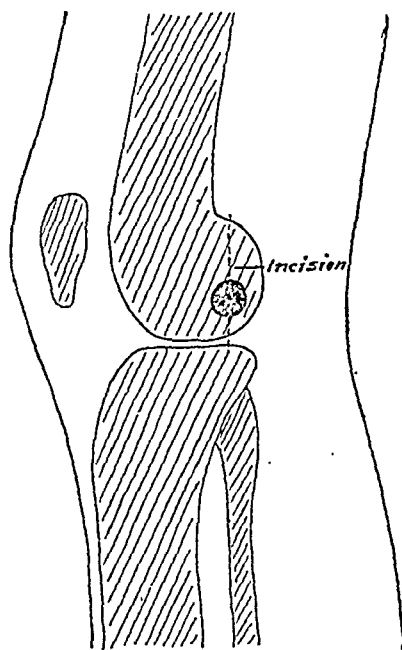


FIG. 6.—X-ray tracing of Case I (lateral view).

ward and inward towards the points determined by the compass localization in order to avoid opening the capsule of the joint. The bone was removed by means of Hudson drills. The greatest caution had to be exercised in drilling the bony channel towards the intersecting point of the two imaginary diagonals indicating the position of the ball, owing to the fact that it is very easy to deviate from the proper plane from the lack of any definite indicator except the skin points obtained by the compass. At the point localized, there was some light-colored tissue like that of the cartilage of the joint. To avoid the possibility of opening the joint this was pricked with a needle and some clear, straw-colored fluid escaped, but nothing was felt suggesting the ball. The needle penetrated for a distance of 1 cm. and appeared to be entering the joint cavity. This process was repeated several times with exactly

the same result. The opening of the bone was enlarged somewhat without finding the foreign body, so that finally an incision was made in this soft tissue where the spherical ball was found perfectly movable in its encapsulating wall. Each time the needle was passed it would slip off of the shrapnel ball and pass down beside it, as is shown in the diagram (Fig. 7). The bone surrounding the ball was removed to some distance and the latter extracted. The wound was closed without drainage; the dead space being allowed to fill with blood clot.

This case is particularly interesting because of the marked mobility of the shrapnel ball after having been encapsulated within the bony condyle. The appearance of the cyst wall, the fluid which

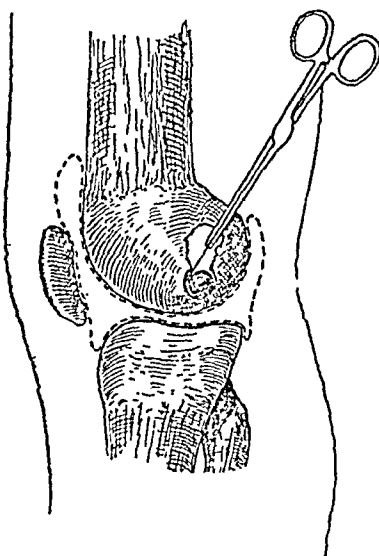


FIG. 7.—Diagram showing the encapsulation and mobility of a shrapnel ball in the femur (Case I).

followed the needle puncture, and the penetration of the needle without resistance made it appear at first sight that the localization had been inaccurate, and that the periarticular tissues were exposed. The ball traversed the popliteal space without injuring either nerves or vessels.

September 1: Wound healed *per primam*. Mobilization started with an adjustable inclined plane; flexion to a right angle obtained.

September 30: Patient started on mechanotherapy. Joint still somewhat stiff. Voluntary movements to an angle of 90 degrees possible.

October 1: Patient walks with a slight limp and has still slight pain on extreme flexion.

November 20: Recovery is practically complete. Still some stiffness from long disuse.

## LOCALIZATION AND EXTRACTION OF PROJECTILES

CASE II.—Admitted May 14. Wounded by shell explosion. Laceration of ring finger of the right hand with fracture of the proximal phalanx, also penetrating wound on the dorsal aspect of the forearm over the middle of the ulna. Wet dressing, rubber tissue drains. The X-ray examination shows a fracture of first phalanx of the ring finger with foreign body on the flexor aspect. Incomplete fracture of the ulna with two shell fragments of considerable size near by.

*Operation* (May 16).—Wound over the forearm enlarged; moderate amount of pus found near the bone; one shell fragment removed, the other could not be found. Small *éclat* extracted from the outer aspect of the ring finger.

July 17: The wound on the finger has healed and the fracture united in good position. There is still some suppuration from the incision from the first operation in the forearm. After compass localization the second fragment was found lying just in front of the interosseous membrane near the ulna. With the assistance of the marks obtained by the compass localization the second fragment was found with considerable difficulty lying immediately behind the median nerve about the middle of the forearm near the focus of osteomyelitis in the ulna. There is often difficulty in following the imaginary diagonals when one passes into the depths of the tissue. Owing to the retraction of the wound edges the maintenance of the plane of incision in exact alignment with the marks upon the skin is not easy. The sinus on the dorsal aspect of the forearm leading to the ulna was enlarged and a small sequestrum removed.

September 3: Suppuration continues from the dorsal incision; that on the palmar aspect has healed.

October 3: Both wounds have healed.

*Comment.*—These two cases show that the compass method of localization, while possessing a distinct advantage over the use of radiographs alone, still gives the operator considerable difficulty in finding projectiles or shell fragments which may be small or deeply placed, owing to the fact that a slight deviation from the lines of the localization may necessitate considerable operative traumatism before the foreign body can be finally located. On this account the next series of extractions were attempted directly under the fluoroscope.

CASE III.—Admitted August 10 from the dépôt at Sens. Wounded June 21, 1915, by shell explosion. The penetrating wound of the left forearm healed after considerable suppuration in six weeks. There is considerable pain on flexing the wrist and

fingers. He has had two operations; at the first a small shell fragment was removed, and at the second the projectile was not found.

*Surgical Condition.*—There is a small scar over the dorsal surface of the ulna at the junction of the lower and middle thirds over on the palmar surface of the forearm. Just above this level are two small scars of the previous operations which are painful. Flexion and extension of the wrist cause great pain. There is no disturbance of sensation. Shell fragments or projectiles in the flexor are much more painful than those in the extensor region; probably due to the greater motion and greater power of the flexor group of muscles and tendons. This condition is quite frequent in wounds of the forearm.

*Operation* (August 23).—Under the fluoroscope. No fragment could be seen in the neighborhood of the scars. One was found about 4 cm. from the incision which could be moved by pressure and was embedded apparently in the flexor sublimis digitorum muscle, the motions of which it followed. The field of operation was prepared and an incision about 3 cm. long made in the skin and subcutaneous tissue. The field of operation was covered with a sterile sheet and fluoroscope used. Under the direct vision of the fluoroscope the muscle fibres were separated in the longitudinal direction until the fragment could be moved by the grooved director which was used for this purpose. A Kocher clamp was then employed and the blades opened when the fragment was touched and the shell fragment withdrawn.

This process, however, is not as simple as it sounds, and a considerable amount of laceration of the tissues was necessary in order to arrive at the exact position of the foreign body, owing to a lack of stereoscopic vision.

*Comment.*—Several operations of this type were performed, but owing to the fact which has been discussed above, that this mode of operating is not rational from a surgical stand-point inasmuch as the tissues have to be lacerated, it was abandoned in favor of other methods.

With the experience gained in these and other cases, we proceeded to develop the profundometer and the harpoon modification of the Sutton localizer.

The combination of these two methods proved so accurate and convenient that almost all of the extractions which were done subsequently were carried out by these combined methods of localization. The harpoon naturally cannot be used in the chest, neck or abdomen for fear of wounding important structures. The charts obtained by the profundometer give all the data necessary for the operation; but the harpoon, if

## LOCALIZATION AND EXTRACTION OF PROJECTILES

it can be employed, facilitates the rapidity and convenience of the approach to the projectile.

The control measurements made at the time of operation indicated that the error in the profundometer method was rarely more than one or two millimetres, and in the majority of cases was absolutely accurate.

The use of the Sutton localizer at the point of incision selected in the cross-section charts obtained by the profundometer gave a rapid and convenient guide during the period of the operation. If the Sutton method is used alone it is not always easy to select the proper incision from a surgical stand-point, owing to the fact that the exact depth of the fragment is unknown. We found, therefore, that the best results were obtained where the two methods were used in combination. The following series of cases will emphasize this point. The cross-section

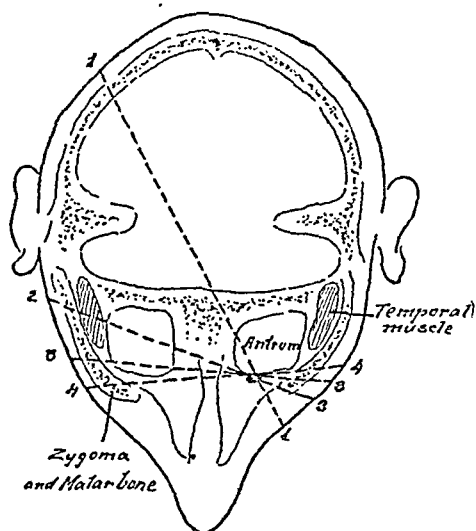


FIG. 8.—Localization chart of Case IV.

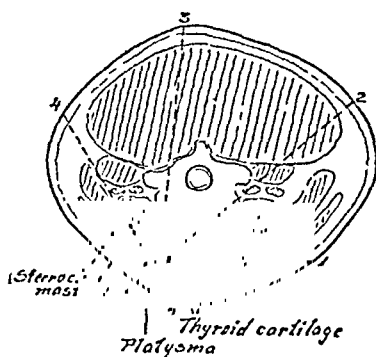


FIG. 9.—Localization chart of Case V.

charts are reductions from those that were obtained at the time the localization was made, and are reduced and made somewhat neater by the artist in copying them. They are arranged in series from the head to the feet to show the adaptability of the method to all regions of the body.

CASE IV.—Admitted November 3 from the Dépôt at Sens. Same patient as Case XVIII.

Wounded July 14 in the Argonne, by shell explosion in the face and leg. On the left cheek over the canine fossa, just below the malar bone about midway between the eye and angle of the mouth, is a healed penetrating wound. Cicatrix is not tender. There is no pain or disturbance. Localization by the profundometer shows (Fig. 8) a small shell fragment in the anterior wall of the left



antrum. Inasmuch as there was no definite indication for operation, this fragment was not removed, and is described to show the ease with which the profundometer can be used in parts of the body with an extremely complex configuration like that of the head and face.

CASE V.—Admitted November 16 from the Dépôt in Sens. Wounded July 15 in the Argonne. Healed wound of entrance just above inner third of left clavicle. An irregularity can be felt on the right side of the thyroid cartilage. It is slightly tender. There is slight pain on deglutition. The radiograph and fluoroscopic examination show a foreign body at the level of the sixth cervical vertebra just to one side of the thyroid cartilage. This is movable, rises with deglutition, and is tender on pressure. With the profundometer the projectile is (Fig. 9) found to lie near the thyroid cartilage and underneath the anterior border of the sternocleidomastoid muscle.

*Operation* (November 20).—Under local anæsthesia. The projectile proved to be the core of a German ball which had slipped its jacket, probably a ricochet shot. It passed upward from the wound of entrance and partly through the anterior portion of the thyroid cartilage without perforating the larynx. The thyroid cartilage was somewhat deformed. The scar tissue dissected off and the wound closed without drainage.

November 27: The stitches were removed. Wound healed *per primam*.

CASE VI.—Admitted September 29, 1915. Wounded September 27 at Beauséjour. Penetrating wound at the back of the neck to the right side of the midline about 7 cm. below the occipital protuberance. Patient complains that he cannot move the fingers or the wrist on the right side, has a definite ptosis on the right side, and a contracted pupil. The tongue is protruded to the right, indicating a paralysis of the hypoglossal nerve. The motions of the arm returned a few days after the injury. There is a residual paralysis of the supra- and infraspinatus, which gives the reaction of degeneration. There is no pulsating tumor over the carotid; no bruit; pressure on this side of the neck and over the brachial plexus is very painful. X-ray (Fig. 10) shows a deformed ball at the level of the sixth cervical vertebra at the right side. To our astonishment another ball was found on the left side of the neck just above the clavicle. This was not deformed. On inquiry, the patient stated that he was not wounded before, but a careful examination showed a well-healed small cicatrix near the inner canthus of the right eye at the side of the nose. The patient then explained that he was wounded December 20 of the previous year, and that the ball traversed the hard palate and passed out

## LOCALIZATION AND EXTRACTION OF PROJECTILES

of the mouth without injuring the mandible and came to rest on the left side of the neck just beneath the skin, where it could be easily felt. Patient had withheld this information as a joke.

October 11: Localized (Fig. 11) with the profundometer and the ball found lying just to the right of the trachea and oesophagus in the position of the carotid artery. The ball underneath the skin was not localized.

*Operation.*—Vertical incision along the sternocleidomastoid. Internal jugular vein and common carotid densely adherent to surrounding muscles. The ball was found lying in the common carotid artery, which was thrombosed above and below it. The point also projected a short distance into the jugular vein. As

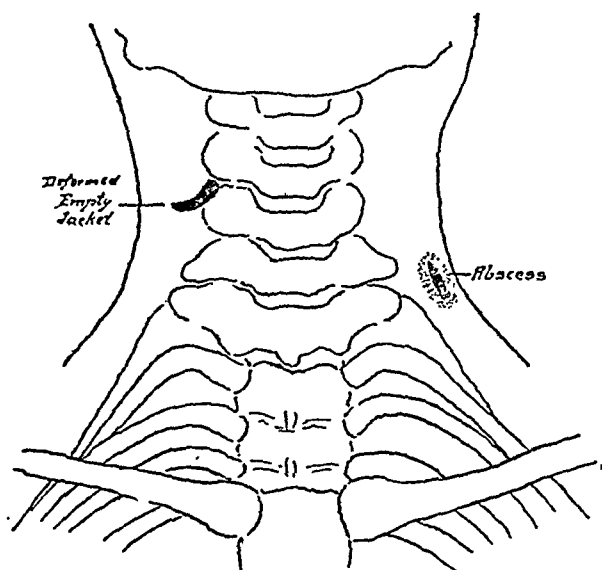


FIG. 10.—X-ray tracing of Case VI (antero-posterior view).

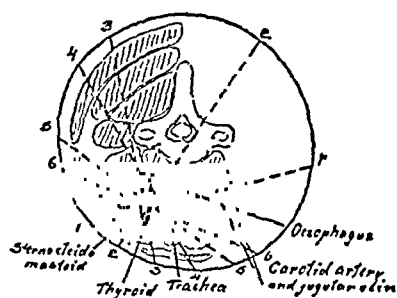


FIG. 11.—Localization chart of Case VI.

the ball was removed there was a sharp hemorrhage from the artery and vein which were doubly ligated above and below the site of the injury. As the projectile was removed it was found to be the deformed jacket of a German ball which had slipped its core, probably a ricochet shot or a machine-gun ball where the heat of the barrel had melted the core. This gave rise to an arteriovenous aneurism, which was occluded by the ball itself with the production of a thrombus in the carotid artery.

The patient did not recover consciousness after the operation, and gave signs of a right-sided cerebral embolism. Probably during the manipulations necessary for the placing of the ligatures about the adherent vessels a portion of the thrombus was dislodged. The patient died two days later without recovering consciousness.

The ball on the opposite side of the neck was surrounded by a

small abscess. This indicates a condition which is not infrequently found where an infected projectile is encapsulated from the surrounding tissues and forms a persisting focus of suppuration.

CASE VII.—Admitted August 20 from the Dépôt at Sens. Wounded April 5, at Bois Le Prêtre. Penetrating wound of the right scapula by shell explosion.

Stayed in hospital three months. Wound suppurated and closed after ten weeks. Since then he has had pains almost constantly in the region of the shoulder. Has noticed since the injury that the angle of the right shoulder drops a little. Had at the time of the injury no pain in the chest and no hæmoptysis.

*Surgical Conditions.*—There is a puckered scar, 4 cm. long and 2 cm. wide, just over the spine of the scapula on the right side; the latter feels rough and was fractured at the time of injury. Between this point and the mid-clavicular region the tissues are somewhat tender to pressure. Abduction of right shoulder slightly limited and somewhat painful. No paralysis of the muscles of the arm or shoulder. Foreign body not felt.

Physical examination is negative except for impaired resonance at the right apex, where there is distinct bronchovesicular breathing both in front and behind, and subcrepitant râles are heard on both inspiration and expiration. The X-ray shows a distinct shadow at the apex. The patient has little or no sputum. Occasional night sweats. There is apparently no connection between this lesion of the apex and the patient's injury; coincidence purely accidental. The X-ray shows an irregular fragment of shell 7 cm. from the end of the clavicle and situated somewhere behind it. With the profundometer the fragment was determined to be at a depth of 5 cm. from the skin in front and 6 cm. from the wound of entrance behind. The fragment thus lay immediately behind and adjacent to the brachial plexus and the subclavian vessels, with the bony barriers of the clavicle and the scapula between the points of localization on the skin and the foreign body, as is shown in the cross-section chart in Fig. 12. As the only operative approach could be obtained from the supraclavicular region, it was necessary to devise a means to obtain a localization from above. This problem I solved in the following way: A piece of lead like that of which the profundometer is made was shaped over the shoulder with the skin points of diagonal number 2 as a guide. These points were marked on this band of lead. Diagonal number 2 was then projected at one side of the cross-section chart and the lead band so placed that the marks of diagonal 2 correspond to the projected lines. Thus a vertical section of the shoulder was obtained from which measurements could be made to the shell fragment. Selecting the anterior margin of the trapezius as the best point for the incision,

## LOCALIZATION AND EXTRACTION OF PROJECTILES

the shell fragment was found to be 5 cm. downward and forward from this point. The method by which this part of the localization was made is shown in Fig. 13 and the result in a vertical plane is indicated at one side of the cross-section chart in Fig. 12.

*Operation* (August 25).—The harpoon was inserted with the aid of the Sutton cannula and the shell fragment removed in a few minutes with novocaine anæsthesia. It was situated just behind the axillary artery and brachial plexus.

September 3: Wound healed *per primam*.

*Comment*.—The interest in this case centres in the fact that no other method of localization could give the necessary data for extraction,

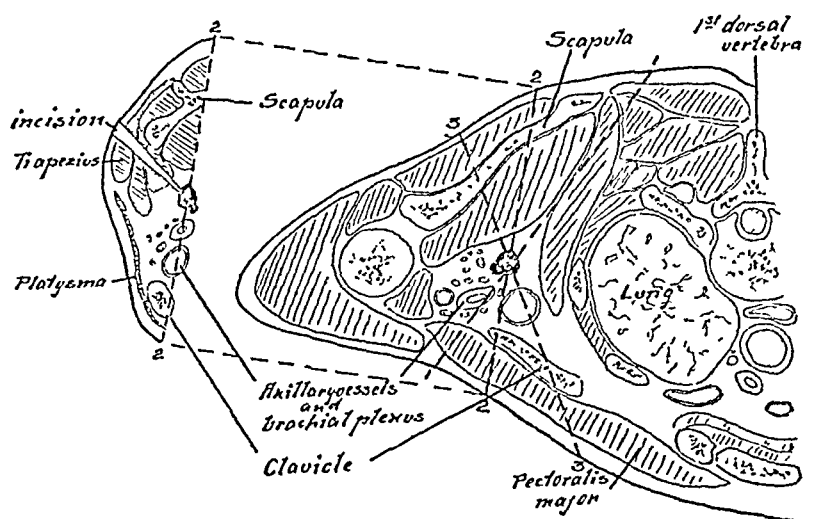


FIG. 12.—Localization chart of Case VII.

owing to the position of the shell fragment behind the bony shoulder girdle. The situation of the shell fragment with reference to the brachial plexus and the axillary vessels would have rendered the Sutton localizer a dangerous procedure without the previous use of the profundometer. It was not until I hit upon the plan of using an extra band of malleable metal to obtain the localizing points for the shoulder at right angles to the horizontal plane of the foreign body that the position of the shell fragment could be determined with reference to the possible operative approach.

**CASE VIII.**—This patient was sent from the hospital at Joiny for localization. He had been wounded in the neighborhood of the left elbow by the explosion of a shell fragment some months before. Wound of entrance is well healed and under the fluoroscope the fragment was found to lie just in front of the external condyle. The position of the shell fragment is shown in the group

of extensor muscles close to the humerus where it can be easily extracted without damage to either nerves or blood-vessels. The cross-section chart, showing the availability of the profundometer method for fragments in the upper extremity, is shown in Fig. 14.

CASE IX.—Admitted October 9. Sent by the hospital at Auxerre, for localization and extraction of a ball near the upper part of the spinal column.

The patient was wounded September 25, by a French ball. The wound of entrance was situated in the left shoulder just below the acromion process. There is an incomplete fracture of the head of the humerus, a comminuted fracture of the scapula, as

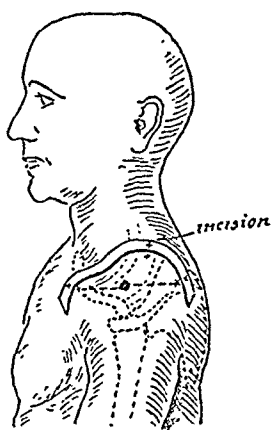


FIG. 13.—Diagram to show the use of a metallic band to obtain measurements and a vertical section over the shoulder at right angles to the original horizontal localization. The result is shown at the left of Fig. 12.

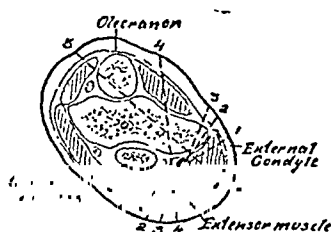


FIG. 14.—Localization chart of Case VIII.

well as a fracture of the angles of the first and second ribs. Pus and gas bubbles can be expressed from the gaping wound of entrance on the shoulder. The patient is very septic.

There is an incomplete paraplegia, but right leg can be moved slightly. The left is completely paralyzed. There is a loss of control of the vesical sphincter and a zone of hyperæsthesia extending over the third, fourth, and fifth interspaces. Below the fifth interspace there is paræsthesia, but not definite anæsthesia. Diagnoses of fracture of the vertebræ and compression myelitis were made. The X-ray shows the shadow of a French ball lying just to the left of the spinous processes of the first and second dorsal vertebræ. The X-ray also shows the fractured humerus, ribs and scapula. The localization of this case was difficult, owing to the paraplegia, and the result is shown in Fig. 15, where the ball was found lying just adjacent to the laminæ of the second dorsal vertebra embedded in the erector spinæ muscles.

## LOCALIZATION AND EXTRACTION OF PROJECTILES

*Operation* (October 9).—Local anæsthesia. An incision 20 cm. long was made with its centre between the first and second dorsal vertebræ. The erector spinæ muscles were separated from the spines on the left side and the ball found exactly at the point of localization. The vertebræ were fractured just at the junction of the laminae and transverse processes. A laminectomy of the first and second dorsal vertebræ was performed so as to relieve the pressure. The dura was not opened, owing to the probability of the ball being infected. Wound closed without drainage and a culture made immediately from the ball. The next morning this was found to be positive for both streptococcus and gas bacillus, so that the wound was immediately opened and freely drained. Patient continued to run a septic temperature and was in extremely

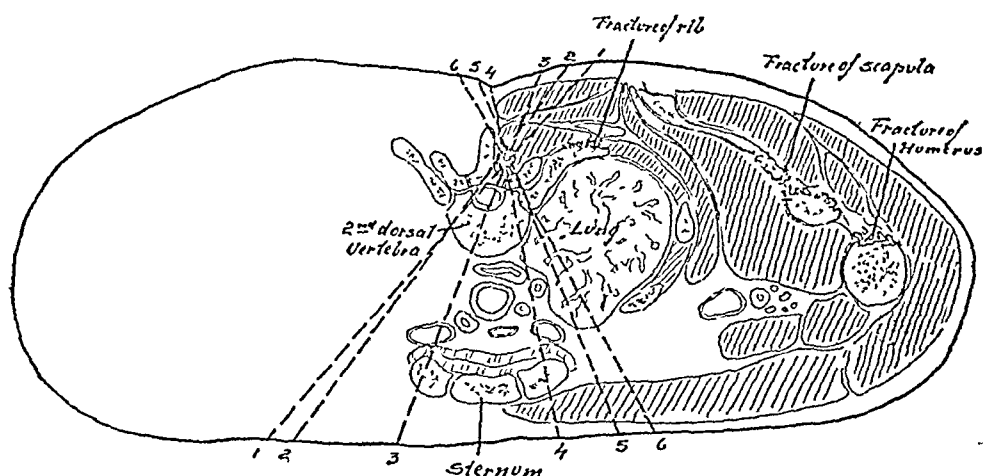


FIG. 15.—Localization chart of Case IX.

poor condition. On November 1 the entire tract of the ball was opened under local anæsthesia and twenty or thirty small fragments of bone removed, which came from the scapula and the upper end of the humerus. Shoulder-joint was apparently free. Up to the time I left the Hospital on November 24 the patient still showed signs of sepsis and only a slight improvement in the paralysis.

CASE X.—Admitted May 14. Wounded by shrapnel at Arras, May 11. Wound of entrance is on the left side of the mandible about 5 cm. from the symphysis. The X-ray shows a ball behind the left sternoclavicular articulation.

He had been operated upon unsuccessfully May 14, the incision being made on the left side of the neck behind the sternocleidomastoid. Ball was not found. Patient showed on neurological examination no nervous lesions, but complained of severe pain on moving the head and left arm. The arm atrophic from disuse.

Localization with the profundometer (Fig. 16) showed that the

shrapnel ball was lying in the superior mediastinum against the body of the second dorsal vertebra just to the left of the œsophagus. Pain is probably due to interference with the movements of the vertebræ during attempts to move the left arm or the head.

*Operation* (August 5).—Low Kocher incision just above the sternoclavicular articulation, the sternocleidomastoid pushed to the left and the incision carried by blunt dissection down to the carotid vessels. These were retracted to the left, the thyroid gland and trachea to the right. The inferior thyroid artery was divided between ligatures which afforded access to the superior mediastinum and vertebral column. A finger was passed down and the shrapnel ball could be felt lying against the body of the second dorsal vertebra. This was readily removed and the wound closed

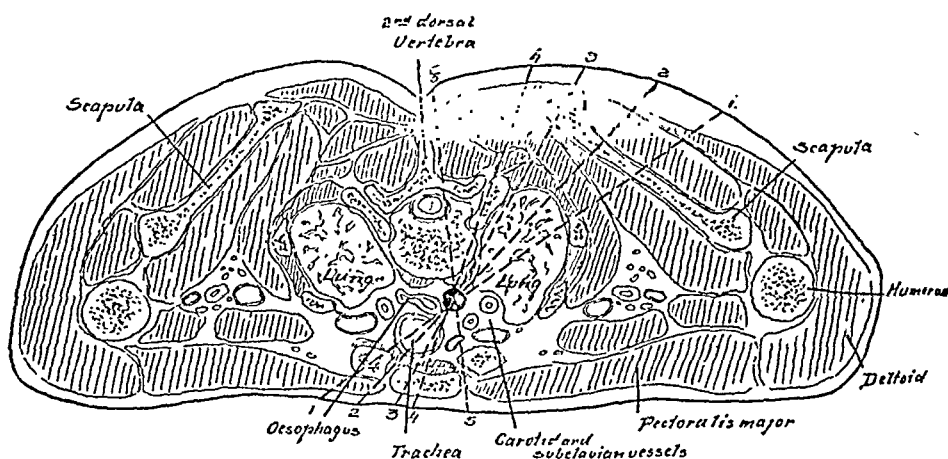


FIG. 16.—Localization chart of Case X.

without drainage. During the operation the pulsations of the arch of the aorta could be easily felt.

August 13: Stitches removed. Wound healed *per primam*.

August 30: Patient started on mechanotherapy. Motions of the arm improving. Pain has disappeared.

September 20: Patient evacuated. Use of arm practically normal.

CASE XI.—Admitted September 11 from the Dépôt at Sens. Multiple wounds by grenade explosion a month before. Wound of the head and right hand, right arm and right thorax at the level of the eighth rib in the posterior axillary line. The wounds on the head, arm, and hand were immaterial. Over the eighth rib there was a suppurating wound together with a definite intercostal neuralgia along the course of the eighth intercostal nerve. Under the fluoroscope a shell fragment was seen on the right side, which moved on in an expiration with the same amplitude as the

## LOCALIZATION AND EXTRACTION OF PROJECTILES

diaphragm. This was thought to be in the lung and, consequently, no attempt was made to find it.

*Operation* (September 15).—The sinus was enlarged where a fractured rib was found with the callus pressing upon the intercostal nerve. This was liberated and the wound drained.

October 9: All wounds healed. At this time the localization was done with the result shown in Fig. 17. The shell fragment, instead of being in the lung as we had supposed, was situated in the latissimus dorsi muscle. This revealed the interesting fact that this muscle apparently moves on in an expiration with the same amplitude as the diaphragm. Shell fragment extracted with local anæsthesia.

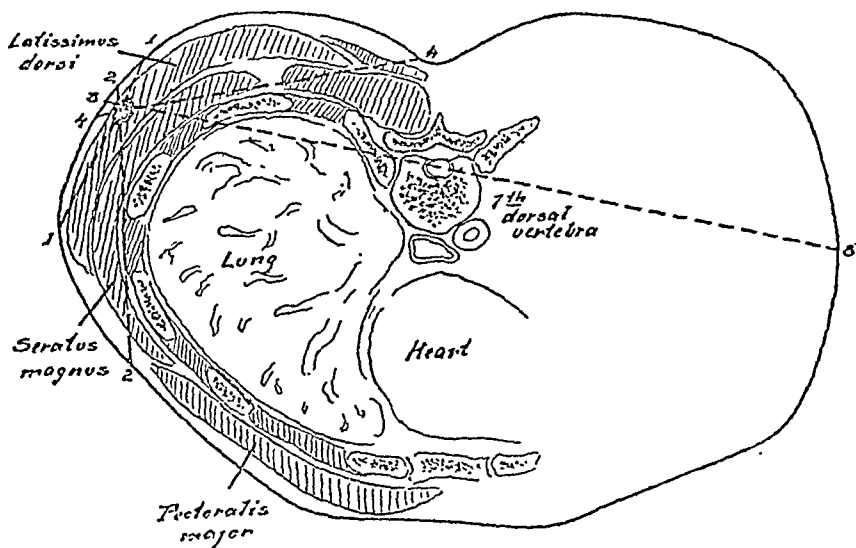


FIG. 17.—Localization chart of Case XI.

CASE XII.—Admitted August 31, from the Dépôt at Sens, with the diagnosis of a ball in the lungs. Wounded March 1 at Bois le Prêtre, in the left side of the chest, by a ball. Immediately after the injury the patient began to expectorate blood in considerable quantities which was accompanied by violent coughing and great respiratory distress. This condition continued for about two weeks and gradually cleared up. Has no cough at present, no pain or dyspnoea.

Examination shows a healed scar 1 cm. in diameter in the left anterior axillary line at the level of the sixth rib. The physical examination of the chest is negative except that the percussion note is somewhat impaired and the breath sounds over the left lower front axilla and base are somewhat distant. Tactile fremitus over this region slightly diminished.

*Localization*.—Instead of the ball lying in the lung as we expected, the chart (Fig. 18) shows that it is lying in the right



ventricle of the heart immediately behind the sternum,  $5\frac{1}{2}$  cm. from the skin. Inasmuch as the patient had no symptoms whatever, an operation for extraction was contra-indicated.

This case shows one of the remarkable instances of the toleration of the myocardium for a foreign body. The ball had apparently traversed the lung and come to rest in the muscle of the right ventricle, where it healed without symptoms. Heart symptoms, if any existed after the injury, were apparently not recognized, or were masked by the hæmopneumothorax that probably existed at the time his wound was received. Of this injury, no signs remained except a thickened pleura.

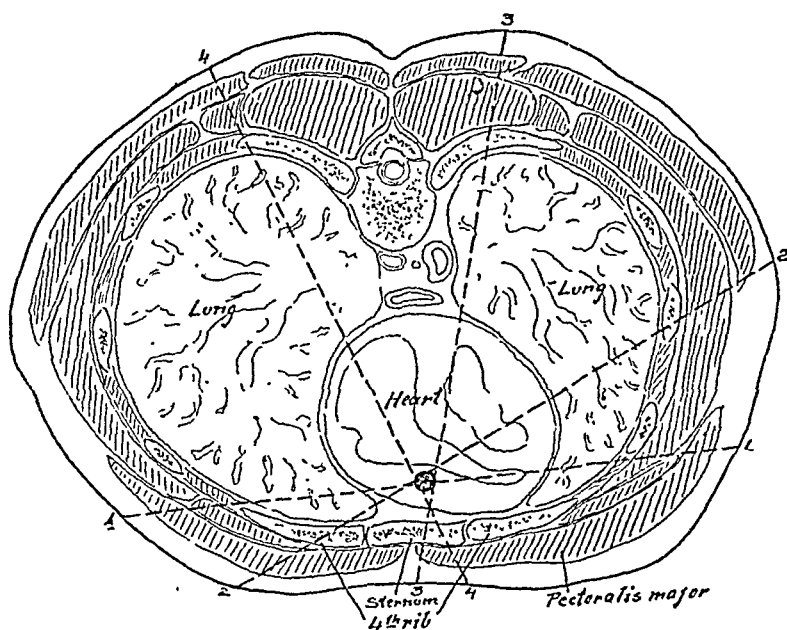


FIG. 18.—Localization chart of Case XII.

CASE XIII.—Admitted September 11. Wounded at Beauséjour on August 22, by ball. The patient shows a wound of entrance over the ninth rib in the right posterior axillary line, from which there is a slight serous discharge. Lungs clear on both auscultation and percussion. The abdomen is soft. There is no general rigidity. There had been no history of hæmoptysis, hæmatemesis, melæna, or peritonitis. There is a point of tenderness over the left linea semilunaris about 3 cm. above the umbilicus. No mass, however, is felt in this region.

Localization is shown in Fig. 19 where the ball is shown about 5 cm. below the level of the skin. It will be noticed that the intersecting lines of the localization vary much more than in any of the previous cases. This is due to the mobility of the ball which moves both on respiration and on changes in the posture of the

## LOCALIZATION AND EXTRACTION OF PROJECTILES

patient. A study of this chart reveals that the diagonals do not intersect at one nodal point as is the case in the other localizations, but a more or less quadrilateral space is formed by the diagonals. This is due to the mobility of the ball with the changes in posture of the patient, localizing the projectile inside of this space, the limits of which mark the extent of its mobility.

*Operation* (September 30).—Left rectus incision. The ball was found embedded among a group of lymph-glands just at the root of the mesentery of the small intestine (Fig. 20), slightly to the left of the aorta. As the cyst wall was opened a small amount of turbid fluid escaped. The ball was easily extracted. Small

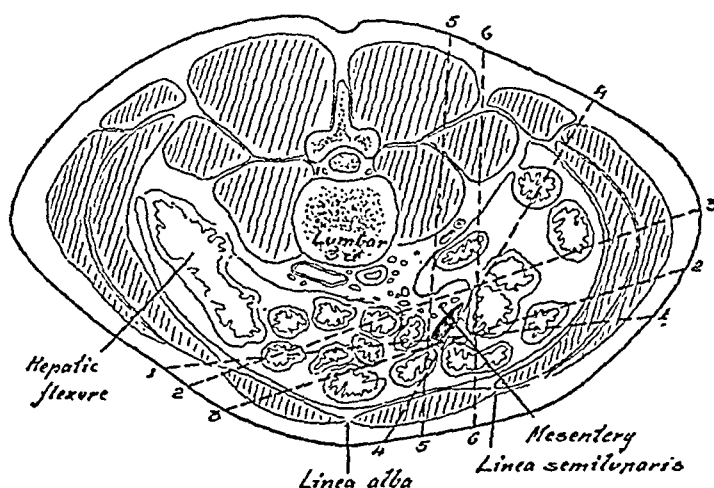


FIG. 19.—Localization chart of Case XIII.

cigarette drain placed to the opening in the cyst until a culture could be made of the ball.

October 1: Culture negative. Cigarette drain removed.

October 9: Wound healed *per primam*.

*Comment.*—This case is interesting because the ball apparently traversed the liver, the great vessels, and came to rest in the mesentery of the small intestine immediately adjacent to the aorta without perforating any of the hollow viscera.

Localization in this case was interesting because the movements of the projectile in the abdomen are shown by the intersecting lines. In an instance like this, the projectile lies in the space formed by the limiting diagonals.

It is, of course, obvious that in abdominal wounds the trochar method of localization could not be employed, owing to both the impossibility of anæsthetizing the abdominal cavity and the danger of perforating the intestines. The profundometer is the only method which could provide accurate localizing data in a case of this description.

CASE XIV.—Admitted August 17 from Hospital at Melun. Wounded in the right buttock, September 16, by shell explosion, at Rheims.

Patient has had three operations in other hospitals, but shell fragment has not been found. On the right buttock just below the crest of the ilium there is a wound of entrance with persistent suppuration. Scars of three other operations are seen; two of these above the crest of the ilium are still suppurating. When the patient contracts his abdominal muscles considerable pus is forced from the wound of entrance on the dorsum of the ilium. At the lower right quadrant there is distinct tenderness, and a deep mass is felt. Pressure of this area causes pus to flow from the sinus.

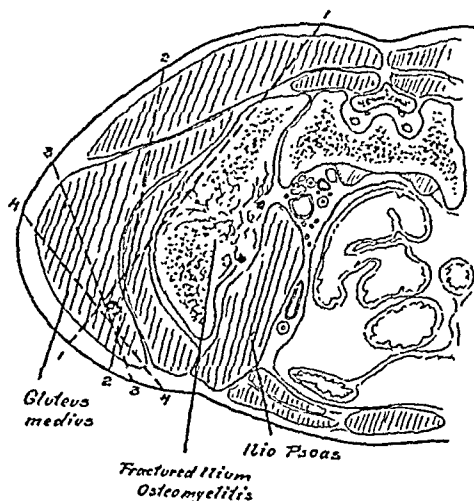


FIG. 21.—Localization chart of Case XIV.

An X-ray examination shows an osteomyelitis of the ilium with an intrapelvic abscess beneath the iliopsoas muscle. There are two very small shell fragments in the intrapelvic abscess and a larger fragment in the gluteal muscles. The sinus was enlarged and a drain inserted.

October 17: With improved drainage the osteomyelitis has subsided and the sinuses have closed. Localization (Fig. 21) shows a large shell fragment in the anterior portion of the gluteus medius, which is distinctly painful on pressure. This is situated 6 cm. below the anterosuperior spine of the ilium and  $2\frac{1}{2}$  cm. from the skin. A harpoon was inserted by the Sutton cannula and the shell fragment removed with local anæsthesia. No attempt was made to remove the two minute fragments of shell in the pelvis.

CASE XV.—Admitted August 23 from the Dépôt at Sens. Wounded at Souchez, June 21, by ball. Well-healed wound of entrance in the right buttock about 5 cm. below and somewhat to the right of the coccyx. No tenderness of the cicatrix. Patient

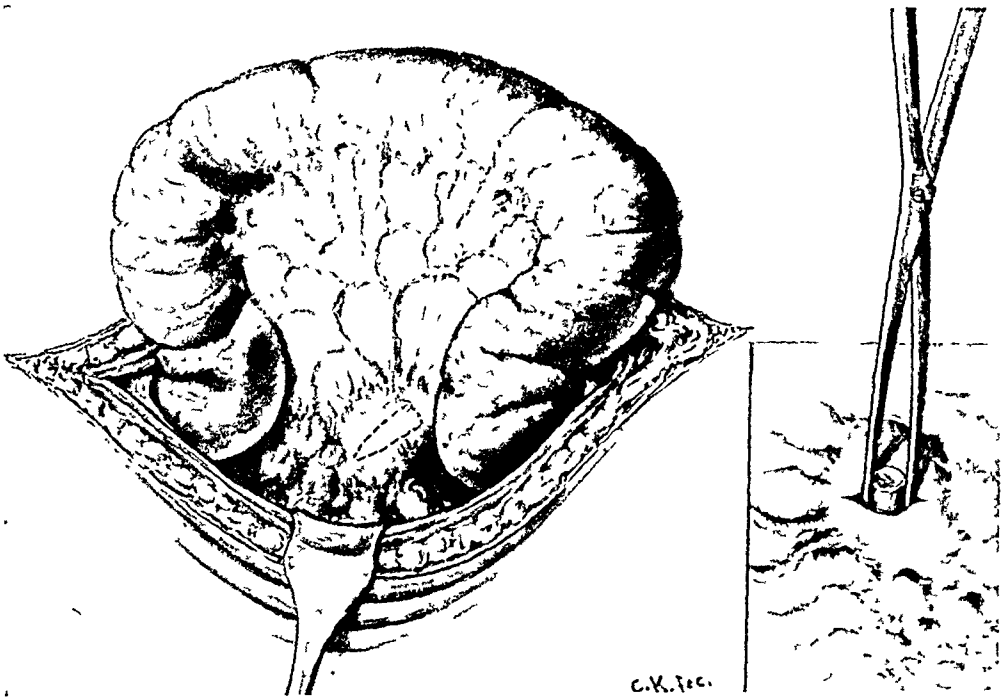


FIG. 20.—Sketch showing a German ball encysted at the root of the mesentery, permitting the mobility found in Fig. 19.



## LOCALIZATION AND EXTRACTION OF PROJECTILES

complains of pain, while marching, near the hip-joint. This is local and does not radiate along the sciatic nerve. The X-ray shows a German ball situated apparently near the head of the femur in the anteroposterior view. Localization (Fig. 22) shows that the ball is situated in the gluteus maximus muscle about 5 cm. behind the greater tuberosity of the femur and 4 cm. from the surface of the skin. Harpoon introduced. Extraction with local anæsthesia.

September 7: Sutures removed. Wound healed *per primam*.

CASE XVI.—Admitted September 29. Wounded September 27 at Beauséjour by shell explosion. The wound of entrance is in the right pudendal fold. The fragment has apparently passed

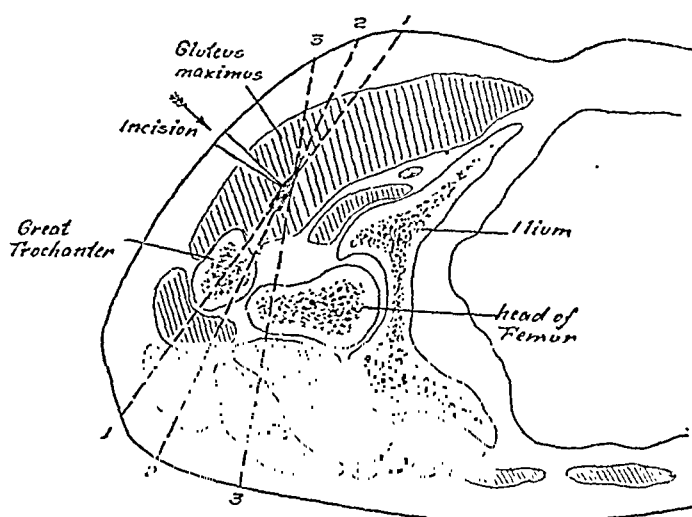


FIG. 22.—Localization chart of Case XV.

downward and forward in the adductor region. Wound healing without reaction. Sterile dressing.

The X-ray shows a shell fragment in the adductor region at the level of the lower end of Scarpa's triangle, internal to the femur.

October 15: Wound is entirely healed. Localization (Fig. 23) shows a large fragment arrested by the adductor membrane immediately behind and internal to the femoral vessels. This is an extremely frequent position for balls or shell fragments to come to rest. Apparently the tough intermuscular septum forms an elastic curtain which is extremely resistant and tends to stop further progress of the projectile unless the velocity is great. We have had at least six or eight similar cases with wounds of entrance in various parts of the thigh.

To avoid the femoral vessels and the larger perforating branches, incision was planned through the adductor muscles. A

harpoon was inserted by means of the Sutton cannula and the fragment removed with local anæsthesia.

October 29: Patient completely healed and out of bed.

CASE XVII.—Admitted September 11. Wounded at Beauséjour, September 8, by shell explosion. Penetrating wound 1 cm. in diameter, situated 3 cm. above the upper border of the patella. Marked effusion into the knee-joint. Patella floats. Fixation dressing.

November 2: Wound is entirely healed. X-ray shows two shell fragments at the same level, one of which has penetrated the femur, making a small depressed fracture. The localization (Fig. 24) showed the two shell fragments at the same level, one 4 cm. from the skin, and the other just inside the femoral shaft. Selecting the diagonal 1, the harpoon was placed by means of the Sutton cannula so that it passed and touched the more superficial

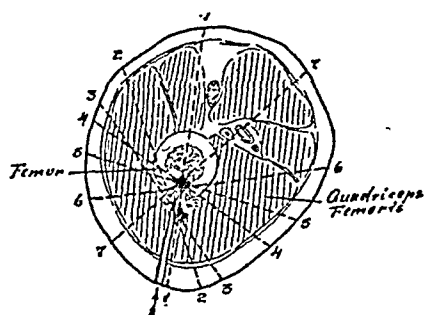
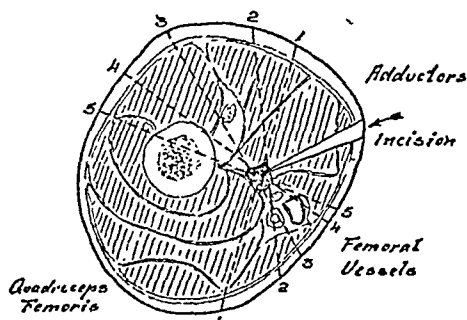


FIG. 23.—Localization chart of Case XVI.

FIG. 24.—Localization chart of Case XVII.

fragment and came to rest upon the deeper fragment. This diagonal was chosen because it was the only one which passed through both fragments.

*Operation* (November 2).—Local anæsthesia. Incision 12 cm. long. Deepened to the level of the superficial fragment which was then extracted. The harpoon was then followed and the deeper fragment found buried in a crater of bone formed by the depressed fracture of the femur. The periosteum was infiltrated with novocaine and the crater chiselled out, so that the fragment could be removed. Wound closed without drainage.

November 10: Stitches removed. Wound healed *per primam*.

November 17: Patient walking without difficulty. Effusion of the knee-joint entirely absorbed.

*Comment.*—This is the first case in which two fragments were localized at the same level. An inspection of the chart shows how accurately the two nodal points where the diagonals intersect give the localization of the two fragments. The selection of the incision here

## LOCALIZATION AND EXTRACTION OF PROJECTILES

was due to the fact that the diagonal 1 gave the most convenient approach to facilitate the removal of both projectiles through the same incision.

CASE XVIII.—The same patient as Case IV. Besides the wound in the face, the patient had eight small wounds on the inner and lower aspect of the thigh. A portion of these wounds were through-and-through, and two were penetrating. The patient remained in hospital two months. Two wounds healed after suppurating for about six weeks. Patient now complains of stiffness of the flexor muscles of the leg. The X-ray shows two shell fragments, one apparently on the inner anterior aspect of the thigh and the other on the posterior aspect near the skin. These are at the same level about 12 cm. above the patella. Localization (Fig. 25) shows that one fragment lies in the vastus internus

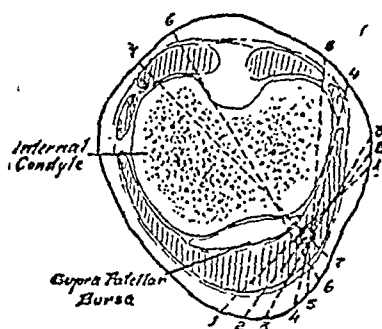
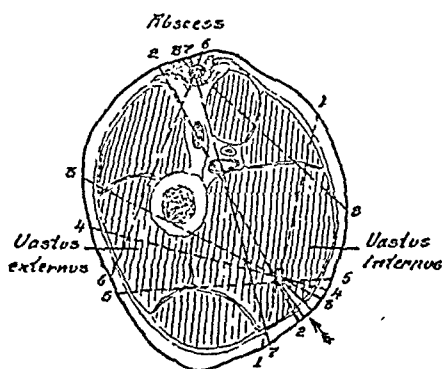


FIG. 25.—Localization chart of Case XVIII. FIG. 26.—Localization chart of Case XIX.

muscle about 2 cm. from the skin. A second fragment is located about 1 cm. from the skin, between the hamstring muscles, and is surrounded by a definite area of induration, like a small encapsulating abscess. Harpoon inserted for the deeper fragment in the vastus internus. This was extracted by its aid. The posterior more superficial fragment was found to be the nucleus of a small encapsulating abscess. Both wounds drained. Both fragments infected.

November 20: Wounds granulating nicely. Both practically healed.

CASE XIX.—Admitted September 29. Wounded September 27, in Champagne.

There is a small gutter wound over the external aspect of the right knee at the level of the patella. Wound is superficial. Joint is not involved. There is a penetrating wound on the external aspect of the left thigh 20 cm. above the patella, with marked swelling about the knee and marked effusion in the joint. Wound of entrance healed without reaction.



The X-ray shows a German ball lying just above the patella close to the external condyle, about 9 cm. above the joint surface. Localization (Fig. 26) shows that the ball lies with its long axis parallel to the long axis of the femur, situated 2 cm. from the skin, and lies in the vastus externus muscle close to the suprapatellar bursa. Ball removed with diagonal 7 as a guide, without the aid of the harpoon. This was omitted owing to the proximity of the joint.

November 14: Stitches removed. Wound healed *per primam*.

CASE XX.—Admitted September 11. Wounded September 9, at Mensil les Hurlus, by aeroplane bomb.

Multiple wounds of the right leg and foot which are of no consequence. Simple fracture of the middle of the right humerus. Lacerated wound over the inner aspect of the left knee, 7 cm. long, with the granulating necrotic base. Marked swelling about the knee-joint and distinct effusion into the joint cavity. The arthritis is probably traumatic. No evidence of infection.

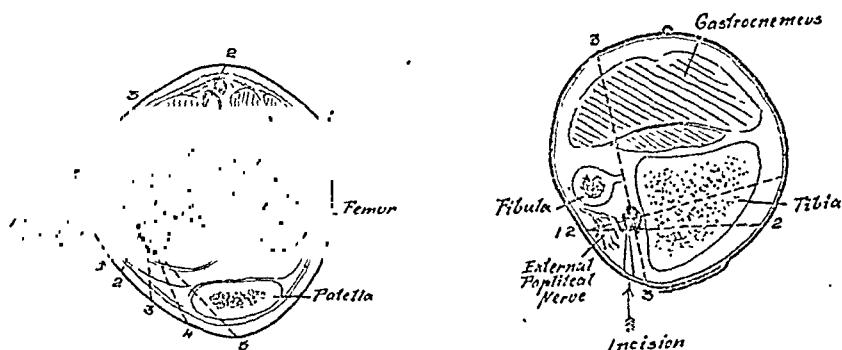


FIG. 27.—Localization chart of Case XX. FIG. 28.—Localization chart of Case XXI.

December 4: Fracture of the humerus is united. All wounds are healed. No functional disturbance from the wound of the knee. Localization (Fig. 27) shows an elongated shell fragment embedded in the internal condyle of the knee just behind the reflection of the capsule.

Owing to the lack of any definite indications for extraction and the inaccessible position of this fragment with reference to the knee-joint, this fragment was not removed.

CASE XXI.—Admitted August 13, 1915. Wounded September 6, 1914, at Noyons, by shell explosion. Penetrating wound on the external anterior aspect of the right leg at the junction of the middle and upper thirds. The wound healed after suppurating for four weeks. Since then the patient has had pain in the outer aspect of the leg, particularly when marching.

The X-ray shows a shell fragment just below the head of the fibula in the peroneal muscles. The fragment evidently lies close to the external popliteal nerve.

## LOCALIZATION AND EXTRACTION OF PROJECTILES

August 30: Localization (Fig. 28) shows the fragment lies in the ankle between the tibia and fibula, close to the internal aspect of the tibia. Incision was selected parallel to the internal aspect of the tibia to avoid the possibility of injuring the external popliteal nerve. This approach rendered easy access to the fragment, which was removed without difficulty with the aid of local anæsthesia.

September 10: Stitches removed. Wound healed *per primam*.

September 25: Patient walking without pain. Apparently the shell fragment pressing upon filaments of the peroneal nerve gave rise to traumatic neuritis.

CASE XXII.—Admitted August 21 from the Dépôt at Sens. Wounded by shell explosion, June 7, near Arras. Wound healed within one month. On July 8 an effort at extraction was made, but the shell fragment was not found. Since then the ankle has remained swollen, and has been painful, particularly when walking. The patient shows a scar 2 cm. in diameter on the inner side of the left tendo Achillis. Immediately behind and somewhat below

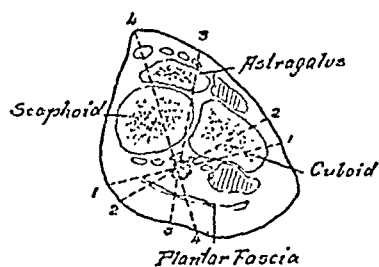
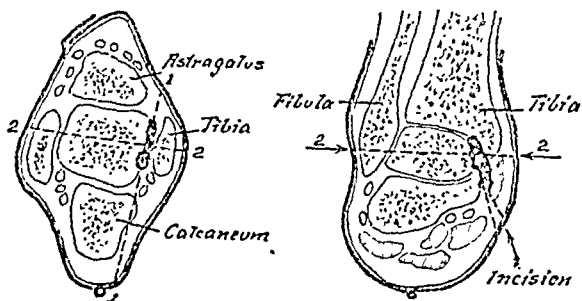


FIG. 29.—Localization chart of Case XXII.

FIG. 30.—Localization chart of Case XXIII.

the internal malleolus is a well-healed scar of operation. The region of the internal malleolus is slightly swollen and tender. There is some voluntary limitation of motion from pain; inversion and eversion of the foot are especially painful.

The X-ray shows a large shell fragment lying partly in the joint between the internal malleolus and the astragalus. Localization (Fig. 29) shows that the shell fragment lies between the astragalus and internal malleolus, in a position where direct operation is impossible owing to the bony barriers. In consequence, the same procedure that was used in the shoulder case was employed, and a second observation made with diagonal 2 as a base extending underneath the foot, and a point of incision selected which extended upward and inward so that the shell fragment could be withdrawn from its position between the two bones. This procedure is shown in the localization chart in this case.

September 3: Stitches removed. Wound healed *per primam*.

September 20: Patient walks practically without difficulty.

September 25: Evacuated.

CASE XXIII.—Admitted August 12 from the Dépôt at Sens. Wounded near Arras, July 7, by shell explosion. Well-healed wound of entrance on the inner aspect of right foot. Since then there has been considerable difficulty and pain in marching, so that the patient is incapacitated from military service.

The X-ray shows a shell fragment lying on the plantar aspect of the foot just beneath the scaphoid and cuboid bones.

September 1: Localization (Fig. 30) shows that the shell fragment lies beneath the plantar fascia in close proximity to the flexor longus digitorum tendons. Incision is made in the plantar aspect of the foot along the direction of diagonal 2, and after wound had been deepened to 3 cm.—the depth indicated on the localization chart—the fragment was immediately felt after the application of the vibrating magnet. This was extracted without difficulty.

September 10: Stitches removed. Wound healed *per primam*.

September 20: Evacuated. Patient walks without difficulty.

This series of cases has been selected from those operated upon to demonstrate the development of the localizing methods, and particularly to emphasize the adaptability of the profundometer and harpoon methods to the various regions of the body. It will be obvious from a review of this series of cases that no one localizing method is adapted to the extraction of projectiles in all cases. The methods must be suited to the requirements of the individual case. We may conclude in general, however, that up to the present time the vibrating magnet and the Sutton cannula with the harpoon are perhaps best adapted for immediate operation on cases fresh from the front, although their limitations must be constantly borne in mind. The profundometer is by all odds the most useful and the most general in its application, and provides localization data upon which practically any extraction can be made. In cases where the foreign bodies lie in the extremities or in the soft parts, the harpoon guide inserted by the Sutton cannula is of great service in providing the operator with a conductor which will lead him directly and rapidly to the foreign body. This, however, should not be employed when the projectiles lie near important nerves or vessels, even in the extremities. It may be asserted that in most cases the use of these localizing methods makes the extraction of the foreign body a minor operation, inasmuch as 80 per cent. of them can be performed by local anæsthesia.

The process of localization is not a time-consuming one, inasmuch

## LOCALIZATION AND EXTRACTION OF PROJECTILES

as the localizing charts can usually be made in a half to three-quarters of an hour. In all grave cases, like those of the chest and abdomen, the localizations were repeated after an interval of several days had elapsed, and the charts obtained from the two localizations made on transparent paper were superimposed. In these instances, localizations made without any reference to each other never showed a variation of more than one or two millimetres. These methods do not require complicated apparatus, and may be employed in any hospital which possesses a good X-ray machine and a good fluoroscope. The profundometer can be constructed by anyone with a little mechanical ability and costs but a few cents, while the Sutton cannula and the harpoon can be constructed by any instrument maker.

# METHODS OF HANDLING INJURIES ON TRANSPORTATION SYSTEMS AND WOUND TREATMENT\*

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CROSSING the Atlantic five years ago in a great ocean liner, four days out at sea, the purser's assistant was seized with an acute attack of appendicitis. Consultations were held with the ship's surgeon and the captain and officers, which culminated in the decree that an operation be performed at sea. A survey made quickly revealed that no provision existed for such an operation—not even the necessary instruments. Under orders of the surgeons, however, the engineers improvised quickly the necessary arrangements, which proved in the end to be effective. The operation was performed at midnight under difficulties. The following afternoon the arrival of the ship at Fish-guard enabled the patient to be transferred to a marine hospital in Liverpool, where he recovered.

Four thousand people occupied the ship for five days, or the equivalent of twenty thousand for one day, and yet no provision existed for the care of emergencies that might under the law of average be expected to develop at any time in such a large concourse of people.

Many questions arise in relation to this subject: What provisions are made by transportation companies to meet the countless emergencies of the day which are the product of the feverish activities of modern industrial life? What is being done to prevent the appalling sacrifice of human life? What are the measures used by the common carrier for the prevention of the crippling and maiming of its workmen and patrons? How are injuries and wounds treated in the field? What are the elements of first aid prescribed and practised? Do they measure up to the standards of the army and navy and those used in civil life?

The principle implied in the shibboleth "Safety First" looms very largely in all social activities organized for the prevention of the great vital and economic waste which is the concomitant of forces allowed to run riot and breed emergencies in an endless chain.

When Josiah Strong, whose death has been recently announced, first initiated the "Safety First" movement, he little dreamt it would

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\* Read before the American Surgical Association, May 10, 1916.

## HANDLING INJURIES ON TRANSPORTATION SYSTEMS

attain such momentum as to become within a short span of two or three years a world-wide movement destined to have great influence upon the welfare of the human family. The American Institute of Social Service was organized by him in 1898, and within two years was extended over the United Kingdom, and at the beginning of the great world war at least five of the warring nations formed institutes along the line of his original organization.

While much may be written of the humanitarian and economic sides of the question of "Safety First," it is probably in the latter that it has found its greatest development. Conditions vary in different countries, and what is being done for the prevention of emergencies in the crowded centres of the East will not find an exact counterpart in the more sparsely populated communities of the West. In the East, emergencies are readily met because they are accessible to the community with its organized institutions. In the West, however, with its great stretches and isolated communities a more complex organization becomes necessary to meet emergencies as they come.

Railroad companies, more than any other organizations, have to consider acutely both the economic and humanitarian sides of this great movement because the law requires them to transport their patrons in safety, and also to protect their employees from the hazards peculiar to their occupation, and, recognizing the great principle of prevention, they have not been slow to adopt it.

The late E. H. Harriman, who in his short but meteoric career showed the world that he was the greatest builder of railroads, seized every principle of constructive character readily and applied it at once for the elevation and betterment of service. After he had financially rehabilitated the Union Pacific in line with his conservative policy in railroad management, he installed at colossal cost the system of automatic block signals over the entire Union and Southern Pacific Systems.

A survey recently made of the emergency service of a western railroad system, one of the links of the Union Pacific, with which I have had for many years official connection, enables me to present to this august body, which should be the arbiter of such large questions, the methods that are in use at the present time and which, perhaps, may be taken as an index of those that prevail at large.

In the study of ideal methods of treating emergencies or injuries on transportation systems the study of prevention should receive the first consideration. It begins with a highly trained and vigilant executive, and predicates the constant coöperation of operating officials and workmen in an unceasing effort to work with such forethought and

care that no break in good order takes place to cause the emergency. It goes without saying that careless and shiftless methods would breed emergencies just as the converse would prevent them.

A factor of great importance in the prevention of accidents is found to be the systematic study of their causes. Committees of safety meet at least once a month and enter seriously upon the discussion of all accidents that happen in all the departments of the system. The discussion, for example, develops that a number of accidents have happened because of the giving way of grab-irons on freight cars leading to the infliction of serious injuries to the workman. At another time it develops that the workmen in a foundry, in violation of the rules of the service, are working without protecting glasses when sparks are constantly flying. A chain of such accidents is recorded and a system of correction immediately applied. It develops, perhaps, that on a foreign railroad system collisions are taking place with increasing frequency. A State commission proceeds to investigate the cause and finds that it is the result of greatly augmented traffic. Remedial measures are applied but accidents continue. Ultimately the management is forced, in the interest of public welfare, to install the automatic block signal, which is the best factor of prevention of the greater emergencies.

*Organization.*—The organization of a hospital contemplates first a corps of surgeons who are under the direction of a chief surgeon. There are surgeons in charge of divisions and districts and also specialists. The chief surgeon is stationed at headquarters, and there are surgeons placed at short intervals on the line, so that the whole system is linked up by a chain of service, and they are all governed by established rules and discipline.

Hospitals are of two kinds: the general hospital for the treatment of severe emergencies and sickness and hospitals for primary and ambulatory treatment. The general hospitals are placed in the larger cities and are furnished with every modern appointment. Accommodations are more frequently given in wards, but the private room is available for the more severe emergency and also trained nurses. The X-ray is universally used in fractures and dislocations.

The emergency hospitals recently established on this system have for their special object the giving of prompt service and possess every facility for the immediate relief of all manner of injuries and their effects. They are placed adjacent to shops and round-houses where many employees are concentrated. The appointments are complete, and a system of records is kept by a nurse, who is in attendance during

## HANDLING INJURIES ON TRANSPORTATION SYSTEMS

the working hours and is qualified to give first aid. It is found that such hospitals diminish the incidence of infections in wounds great and small and are invaluable in meeting such emergencies as hemorrhage and shock.

*Equipment.*—The emergency equipment should include a hospital train or car, stretchers, emergency trunks, emergency handbags, Johnson first-aid cabinets, and stationary surgical cabinets at round-houses and shops. Stretchers are placed at frequent intervals along the line, at even unimportant stations, and on all trains and at the terminals a large number are kept on hand.

The emergency trunks are placed at all division points, and at important stations, where they can readily be moved to the scene of the wreck. At the present time there are fourteen such trunks in use throughout the system. They are intended for large emergencies, and are capable of taking care of fifty or a hundred injured people, and a special trunk, with reserve supplies and comforts, is held in readiness at headquarters. The trunks contain instruments for any surgical operation that may be necessary, a complete assortment of medicines, restoratives, anæsthetics and dressings, together with a variety of splints, including plaster of Paris. (See list of contents appended.) The published time table of the railroad always contains a list of the local surgeons and their addresses and the location of the emergency equipment.

The emergency handbag has proved a most useful utility. It is placed at the disposal of the division and district surgeons at busy points and also on all business cars which are constantly moving over the right of way, and therefore readily in touch with emergencies. When accidents happen they are brought quickly to the scene, and not infrequently a travelling physician or surgeon has found them of great service. They contain dressings and bandages to take care of a dozen or more cases, and instruments to deal with ordinary emergencies and also medicines, restoratives, and anæsthetics. (See list of contents appended.)

A very valuable utility is a stationary surgical cabinet which is placed in shops and round-houses for the immediate treatment of wounds and for the prevention of infections. It is made up of a series of shelves and drawers with facilities for holding basins, and is equipped with standard solutions and first-aid packages for the treatment of injuries.

Emergency hospital rooms are also being installed at terminals and large stations. In the city of Seattle the plan consists of a waiting room



and an operating room containing every appointment for a major operation. It is a model of its kind and is equipped for the storage of emergency supplies.

Rest rooms with trained nurses in charge are maintained in large office buildings for the comfort and care of employees and for the treatment of minor ailments. The popularity and usefulness of this service have been attested many times.

In former times, emergency first-aid packets were placed in suitable receptacles in baggage cars on trains, but it was found impossible to keep them stocked because of the pilfering of their contents. It is now proposed to place the various first-aid packets in stations under the control of the agent who would be authorized to issue them at a nominal cost, say ten cents, to any employee needing them. In theory the fee would be charged not for profit but for the prevention of waste.

*Transportation.*—The ideal method of transportation would be a train of several cars always in readiness, one for the transportation of the injured, a second for general treatment, including operations, and a third for the accommodation of the staff, nurses, and attendants. The drawback to this method, however, would be that this costly outfit would not be available when needed. The practical method would be a single car converted for immediate use, the most available being a Pullman coach, and perhaps the most effective of all would be to have on each division a converted day coach or even caboose car marked with the red cross always in waiting at division points, having accommodations for five or six cots and a small compartment designed for emergency operations. Such cars should possess at all times complete equipment for immediate mobilization with the general wrecking outfit to the scene of the wreck.

*System of Mobilization.*—When emergencies happen the news is received by the dispatcher, who in turn notifies the superintendent, whose actions are governed by the character of the emergency. In train wrecks the general wrecking outfit would assemble the equipment *en route*; the dispatcher would summon the nearest division and district surgeons and engage other available surgeons to meet the situation. Every dispatcher should have in mind at all times the location of all the hospital equipment and direct its mobilization by wire.

When single injuries take place it is found that the first passing train furnishes in most cases convenient and timely transportation, and instructions are wired to the point of destination to have an ambulance in waiting. Formerly, when emergencies happened at remote places, a possé of the train crew would have to run to the station, perhaps ten

## HANDLING INJURIES ON TRANSPORTATION SYSTEMS

miles or more, to make notification of the wreck. In these days the telegraphphone, which is carried on every train, is used to send the news direct to the nearest dispatcher, who thereupon alone commands the operations. He directs everybody and everything necessary to the scene of wreck.

*First Aid in the Field.*—Three types of first-aid dressings are proposed: (1) a simple sterile dressing; (2) the hypertonic salt dressing; and (3) a dressing recently devised and which will be described in due course.

The first dressing consists of two pieces of gauze, the larger  $40 \times 3$  inches and the smaller a bandage loosely folded  $18 \times 1\frac{1}{2}$  inches. These are enclosed in a loose glazed paper cover so placed as to envelop the gauze and enable the dressing to be picked up without soiling when being applied to the wound. This dressing is packed in a small envelope hermetically sealed. The second dressing is larger and contains two pads of gauze,  $40 \times 3$  inches, a triangular bandage, and two safety pins. The triangular bandage is designed for various uses, such as the sling, the tourniquet, and to retain bandages. It is sealed and ready for use in compact cartons. The gauze elements in both these packets may be made a hypertonic salt dressing by immersion in a 5 per cent. solution of sodium chloride and allowing the salt to crystallize in their meshes, thereby making it a sodium chloride gauze. We would recommend first-aid dressings to be made in four sizes: the first and second corresponding to the simple sterile or hypertonic dressing already described for small wounds; the third of gauze of two sizes, one and five yards in length respectively, folded in eight layers four inches wide, and sealed in cartons.

The two larger first-aid packets constituting the third variety are intended for the larger types of wounds. It has been determined many times that wounds become refractory to treatment and develop infections because they have not been sufficiently protected by dressings; a diminutive dressing, however good it may be, cannot be expected to protect a wound that is extensive. It is therefore advised to use dressings that will not only carry therapeutic but also protective and mechanical advantages. In compound fractures and all wounds with large areas the large first-aid gauze dressing will be found of priceless value.

The experience of surgeons in the great war has revealed the merit of certain preparations in wound treatment, and there would seem to be a general consensus as to the value of common salt. It seemingly acts by stimulating the migration of leucocytes and promotes the outflow

of the fluid constituents of the tissues, thus favoring drainage. By combining with it sodium citrate in 0.5 per cent. strength the coagulation of the blood is prevented, thus further favoring the outflow to the surface and serving the principle of drainage.

The third variety of dressing, already alluded to, may also be prepared in four sizes, although the general efficacy of the sterile and hypertonic dressings for small wounds would make any other superfluous. It is necessary for this dressing to have a standard solution, which is made up of the following ingredients; metallic iodine one part, pure liquid green soap, neutral to litmus, ten parts, rectified spirit fifteen parts, and sterile water to make one hundred parts. If the preparation were found unstable because of the alkalinity of the soap, the iodine might be added at the time of use in the strength indicated.

The soap content of this dressing is most effective, acting as it does upon the entire surface with which it is in contact, cleansing and purifying it. Thus its lather emulsifies all the *débris* not only in the wound but on the skin, and, holding it in suspension and forming a pellicle over the wound's surface, it offers a barrier to infection. When the dressing is removed at the time of the first surgical treatment the gentlest irrigation will suffice to sweep away all the scum that has collected, enabling the surgeon to proceed with the treatment of the wound without the further infliction of trauma. The soap content further has the effect in contact with all foreign matter, blood clots, and infective material in general, of liquefying or cleansing them, favoring their elimination and acting as an emollient and detergent agent. The emulsified product of the wound naturally seeks an outlet in the gauze which abundantly surrounds the wound.

The iodine content of this formula is effectively germicidal and non-irritating, and has a similar effect to the hypertonic solution in promoting phagocytosis.

The alcohol content is useful as a mild antiseptic, and its value is enhanced because of its association in this preparation with the soap and iodine. The soap emulsifying and disintegrating clots and other infecting elements enables the alcohol and iodine to attack with greater effect. The action of this formula is favored by the movement of muscles or broken fragments of bone in transit.

We have not had an opportunity of studying intimately the time factor in relation to infections without the previous use of first-aid dressings. We have, however, observed many times in cases of compound fractures which have not received first-aid service of any effective kind in the field, that after the lapse of from five to eight hours

## HANDLING INJURIES ON TRANSPORTATION SYSTEMS

before the institution of treatment we have successfully overcome the tendency to infection by preparations in common use in our service into which rectified spirit enters very largely as a detergent agent. Other things equal, we would expect, in wounds that had received the elements of infection, exposure having lasted from five to eight hours, that the soap, iodine, and alcohol formula would be a more powerful factor in the control of infections than the hypertonic salt preparation. There would be no fear on our part to treat small wounds five hours after infection with either of the preparations, but the belief is strong that the protective principle would rest in favor of the soap formula.

One of the vital factors in first aid in the larger emergencies with fractures and dislocations is the use of an effective splint adapted to general conditions. For this purpose we have found nothing better than the woven-wire material known as fruit-growers' wire of  $6 \times 6$  mesh (six of its squares are equal to a linear inch). It is made of galvanized wire, each mesh being soldered together, which makes it very pliable. When additional fixity is needed it can be doubled or trebled in thickness. Its yielding and pliable qualities adapt it to the protection of parts rendered vulnerable by injury. As a substitute, nothing will be found superior to the familiar blanket or pillow splint so generally known, and the first-aid equipment should include a variety of quilted pads to line them. The majority of wounds treated in the field by these methods will be found very often to unite by first intention or to pursue a favorable course in healing by granulation.

The surgeon will very often have to determine at the moment of treatment the procedure that is immediately necessary, and it will be found quite often that in the case of wounds in which the soft parts have been lacerated and deeply contused, or crushed to a pulp, it will be necessary to trim away with scissors and knife all the dead, devitalized tissues, carrying the resection to a degree that the wound at last presents at every point a fresh, ruddy, healthy bleeding surface. So clean may a wound of this kind be made by the removal of all doubtful tissue that a primary skin-grafting operation might even be contemplated. This has been done several times very successfully in our clinics.

It is impossible to lay down any formula for the treatment of infected wounds; one must be governed by the findings in the case. The principle of drainage looms largely in such cases, and must be determined by the surgeon at the time. We have never found any advantage in the use of strong antiseptics, such as carbolic acid and even iodine. Many times after every pocket has been found and suitable

incisions made, we have constantly found that rectified spirit possesses the most salutary effect after being placed in contact thoroughly with all parts of the wound. Drainage with sterile gauze afterward, or gauze impregnated with rectified spirit, has been found constantly to give the best results.

In conclusion, it should be the policy of every railroad company to develop as many skilled men as possible who would be of service in emergencies: conductors, station agents, engineers, and foremen in all departments should receive systematic instruction in classes through a series of lectures and demonstrations, and the system of instruction should be kept up until they have been proved competent by examinations.

The direction of this service and the conduct of its details should be in the hands of a medical officer whose chief function would be to travel constantly over the system giving instruction and guarding the emergency equipment.

#### CONTENTS OF EMERGENCY TRUNKS

Breakable tube with threaded needle.  
 Catgut, 1 dozen.  
 Silkworm-gut, 1 dozen.  
 Silk, 1 dozen.  
 Gauze bandages, assorted, 5 pounds.  
 Muslin bandages, assorted, 2 pounds.  
 Sublimated gauze, 1-yard cartons, 24.  
 Plain gauze, 1-yard cartons, 12.  
 Absorbent cotton, 5 pounds.  
 Picric acid gauze, 6 boxes, 1 dozen each.  
 Antiseptic tablets, 1 bottle, 500.  
 Safety pins, Nos. 1, 2, and 3, 2 dozen each.  
 Tank package, catgut, 1; silk, 1.  
 Pyramid pin, 1.  
 Adhesive plaster, 1-inch, 1 roll; 2-inch, 1 roll; 3-inch, 1 roll.  
 Yucca palm splint material, Nos. 1, 2, and 3, 1 dozen each.  
 Porcelain steel basins, white enamel, 3.  
 Alcohol lamp, 1.  
 Hypodermic syringe (all metal with four bottles), 1.  
 Chloroform, 500 gm., 1.  
 Ether, 500 gm., 1.  
 Alcohol, 95 per cent., 1 pint.

## HANDLING INJURIES ON TRANSPORTATION SYSTEMS

Turpentine, 8 ounces.  
Green soap, 8 ounces.  
Esmarch inhaler, 1.  
Plaster-of-Paris bandages, 1 dozen, 3-inch.  
Oiled silk, 5-yard roll, 1.  
Soft rubber catheters,  $\frac{1}{2}$  dozen.  
Hand brushes, 2.  
Glass graduate, 2-ounce, 1.  
Brandy, 1 pint.  
Carbolic acid solution, 4 ounces.  
Compressed towels, 1 dozen.  
First-aid packages, 1 dozen.

### INSTRUMENT ROLLS CONTAINING

Amputating knife, 1.  
Mathieu's needle-holder, 1.  
English scalpels, 2.  
Straight bone forceps, 2.  
Thumb forceps, 1.  
Key-hole saw for cutting splints, 1.  
Tongue forceps, 1.  
Curved scissors, 1.  
Grooved director and tie, 1.  
Pean's artery forceps, 3.  
Bandage shears, 1.  
United States Army tourniquet.

### CONTENTS OF EMERGENCY HANDBAG

4 packages 1 yard red cross gauze.  
2 packages 2 ounces absorbent cotton.  
2 packages 1-ounce absorbent lint.  
1 package 1-inch  $\times$  10-yard adhesive plaster.  
4 rolls 3-inch gauze bandage.  
4 rolls 2-inch gauze bandage.  
3 rolls 1-inch gauze bandage.  
1 box picric acid pads.  
1 bottle synol soap.  
1 tube unguentine.  
1 roll, 12  $\times$  14 inches, oiled silk.  
2 papers safety pins.

- 1 bottle antiseptic tablets.
- 1 needle-case.
- 1 hypodermic syringe filled.
- 6 envelopes of sutures with needle.
- 1 dozen splint wood.
- 3 3-inch plaster-of-Paris bandages.
- 1 1¼ Squibb's ether.
- 1 flask of brandy.
- 1 case of instruments.
- 1 case of medicines.
- 1 pound of boric acid.
- 1 United States Army tourniquet.

## CHRONIC GENERAL INFECTION WITH THE BACILLUS PYOCYANEUS \*

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THE following paper contains a brief statement of the prominent symptoms of pyocyanic infection, together with the main facts in its pathology, and a somewhat detailed report of an instance of the more unusual chronic form of the disease.

Systemic infection with the bacillus of green pus, which was first scientifically studied in man and animals by Charrin, some thirty years ago, occurs in two forms—the acute and the chronic. The former runs its course in a few days, while the latter may persist for weeks, months or even years. It is a serious disease, often resulting fatally, although recovery occasionally takes place. It is usually observed in infants and young children, although many cases have been reported in adults, and their number will probably increase as familiarity with the symptoms becomes more general. The acute form is by far the more common, the chronic apparently being so rare that only a few cases have been reported.

*The acute infection* comes on suddenly, with violent gastro-intestinal symptoms. There is purging and vomiting, high fever of the septicopyæmic type, headache, and pain in the back and limbs, often extremely severe. In a short time a cutaneous eruption appears, mostly upon the trunk and extremities, which is erythematous and even hemorrhagic in character and manifests itself in reddish or bluish macules and papules, and occasionally blisters, pustules or petechiæ. Death in a few days is the usual outcome.

*The chronic infection* usually begins acutely, although this is not always so. After its acute stage is past there sets in a long course of irregular septic fever, accompanied by chills and sweats, by a more or less marked cutaneous eruption, and by neuralgic pains in the extremities, mainly the legs, which are often followed by paresis and marked atrophy of various muscles. The disease may continue almost indefinitely, leading to great weakness, emaciation, hebetude of mind and generally death.

In both the acute and chronic forms, pleuritic, pulmonary, meningeal

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and nephritic complications are not uncommon, and enlargement of both spleen and liver is quite constant, especially the former. Cirrhosis of the liver and kidneys has been observed in the more chronic cases, as well as perihepatitis and effusion into the various serous cavities, such as the pericardium, pleura, meninges and joints. Icterus may be present, from involvement of the liver.

The leucocyte count is increased but little, if any, and may even be markedly decreased, owing to the presence in the blood of a leucocidin.

Careful pathologic investigation (Fraenkel) seems to show that the bacillus pyocyaneus is not a true blood parasite. In other words, it does not grow within the blood, as do the micro-organisms of a true septicæmia, but merely uses the blood as a means of transportation from one locality to another, so that blood examinations may reveal the germ at intervals only or not at all. In fact, it is much more likely to be found in the bile than in the blood, owing to its predilection for the liver, together with other parenchymatous organs. Wherever it finds lodgement, however, it multiplies rapidly within the walls of the vessels and in their immediate vicinity, thus accounting for the hemorrhagic phenomena and infarcts which so frequently manifest themselves in the skin, the kidneys, the gastro-intestinal tract, the liver, the spleen and the lungs. It has often been detected in the urine.

The bacillus may gain entrance to the circulation in several ways—through lesions of the skin or mucous membranes (ear, nose, tonsils, accessory sinuses, gastro-intestinal tract, etc.), through the teeth, through the umbilicus, in infants, and possibly through the lungs. The intestinal tract has been regarded as a common source of infection by many observers, although actual demonstration is of course difficult, the idea being based upon the frequent finding of the germ in the stools and the apparent absence of all other sources of infection.

The following case is presented because of its unusual surgical aspects and its extreme chronicity—so far as I am aware, only one other instance of equally long duration having been reported (de la Camp).

The disease began acutely, but soon became chronic and lasted continuously for between ten and eleven months, finally ending in recovery, with the exception of a moderate paresis of the lower extremities, which is still undergoing improvement. It defied diagnosis by many physicians, both in Denver and Chicago, until finally its cause, the bacillus pyocyaneus, was discovered more or less accidentally, during the course of a cholecystostomy, and a curative vaccine administered.

## CHRONIC GENERAL PYOCYANEUS INFECTION

CASE REPORT.—On November 22, 1914, the patient, a physician fifty-one years of age, experienced, without appreciable cause, a marked chill accompanied by purging and vomiting. There was severe headache and backache and the temperature rapidly mounted to  $104.5^{\circ}$ . Within 24 to 48 hours a considerable improvement took place, in which the fever almost disappeared and recovery seemed assured. At the end of another day or two, however, the temperature again rose to  $102^{\circ}$  or  $103^{\circ}$ , with daily exacerbations and remissions at irregular intervals. The headache and especially the backache were extreme and accompanied by great pain in the lower extremities, which was described as beginning at the hip and passing downward over the whole limb in a sort of "wave," which finally concentrated in the calf.

In three or four days from the inception of the attack there appeared on the right ankle a hard, red, raised wheal of considerable size, which was sore to the touch. In a few more days a reddish eruption broke out over the entire body, especially upon the extremities. It was maculo-papular in character, each spot being about the size of a pea. The trunk was only moderately affected and the face not at all, although there were a number of spots around the edge of the hairy scalp.

The eruption, together with the pain in the back and other symptoms, at first led to a tentative diagnosis of small-pox, which was soon changed, however, to erythema multiforma. In the third week there appeared an erythema nodosum, the nodules being tender and some of them as large as a twenty-five-cent piece. Even the soles of the feet and palms of the hands were affected. There were at no time any pustules and but one or two blisters.

This eruption occurred intermittently for about nine months, growing, however, gradually less. It would appear rapidly and then slowly fade until it almost disappeared between the attacks.

The pains in the limbs lasted for about six months, although varying greatly in intensity from time to time. They were particularly severe just before the exacerbations of the eruption, and seemed to be distinctly associated with it.

Gradually there developed a paresis of the lower extremities, with muscular atrophy, which persisted after recovery and still exists, at the end of over a year, to such an extent that the patient walks with some uncertainty and uses great caution in going up and down stairs.

Fever appeared daily, at irregular times, during the entire illness, occasionally as high as  $104^{\circ}$  or over, but usually from  $101^{\circ}$  to  $103^{\circ}$ . It was accompanied by severe chills and profuse sweats, followed by a sudden drop to far below normal, sometimes so far that it could not be registered. It always rose rapidly,

stayed at its highest point about half an hour, and then quickly declined (see Fig. 1). Sometimes there were intervals of a day or two when the fever almost if not quite disappeared and false hopes of improvement were entertained.

The result of the long illness was extreme weakness and emaciation, accompanied by considerable mental hebetude, although this did not appear for about six months. Constipation

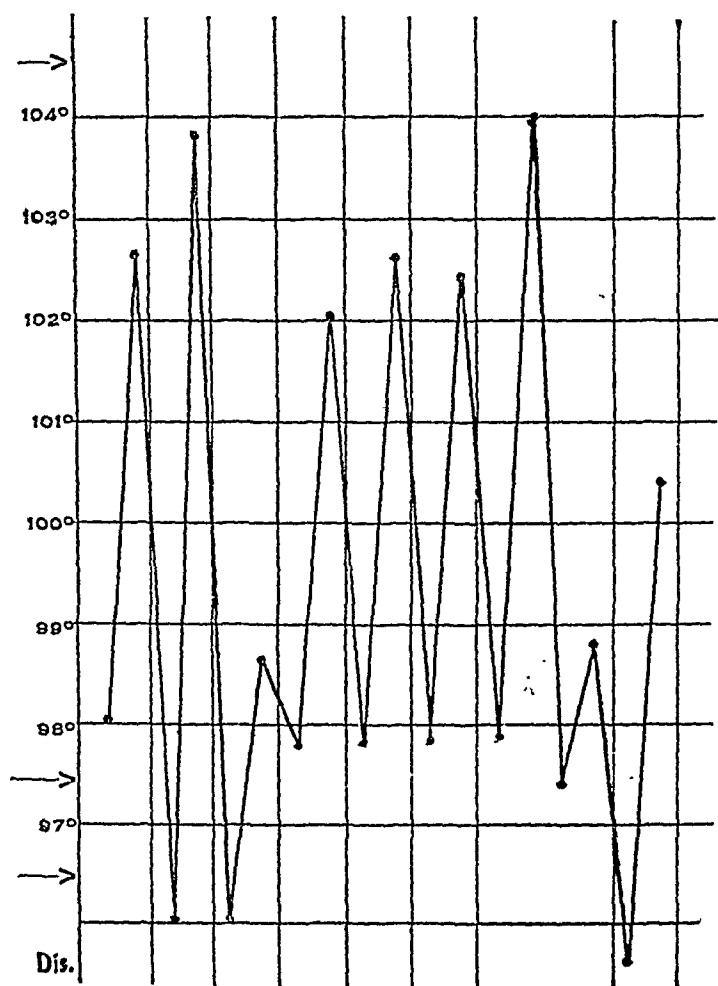


FIG. 1.—Typical excerpt from temperature chart, January 13 to 22, 1915.

was present throughout, following the short initial diarrhœa. The urine was always negative. No lesions of the ears, the nose or the accessory sinuses could be determined, either clinically or by the X-ray, and the heart sounds were always normal.

The diagnosis being doubtful, at the end of three or four weeks, the patient decided to go to Chicago, where he visited the clinic of Dr. John B. Murphy. After an exhaustive examination, in-

## CHRONIC GENERAL PYOCYANEUS INFECTION

cluding blood tests, spinal punctures and animal inoculations, which were all negative, a diagnosis of Rocky Mountain spotted fever was made. Against this, however, were the facts that the patient had not been recently in a tick-fever district, and the season of the year when the disease began was at least two months too late for infection from ticks to occur. After returning to Denver the element of time soon definitely disposed of the diagnosis of spotted fever, and other causes for the trouble had to be sought.

At the end of three months, with the idea that pyorrhœa might be the source of the difficulty, an X-ray picture of the alveolar processes was taken, disclosing several pus pockets. An anæsthetic was then given and all of the teeth extracted, in order to remove with certainty every source of dental infection; but from this heroic measure, although justified by the seriousness of the disease, nothing definite resulted. It is quite possible, however, that the pyorrhœa may have been the original source of infection.

From time to time during the long illness, various blood examinations were of course made, including a Wassermann test, a von Pirquet test, leucocyte counts, bacteriologic investigations, etc., but nothing of practical importance was disclosed, although some two weeks after the disease began the *proteus vulgaris* was detected, but it was difficult to attach any especial significance to its presence and it was not found again. About this time, examinations of the blood, made by Drs. Hillkowitz and Hill, showed: hæmoglobin 80 per cent.; red corpuscles 4,200,000; white corpuscles 12,000 to 13,000; lymphocytes 9 per cent.; polynuclears 87 per cent. to 94 per cent.; large mononuclears 4 per cent.; microorganisms (smears and cultures) absent; typhoid and paratyphoid tests negative; and malarial plasmodia absent. The results of guinea-pig inoculations were negative.

At the end of about five months, attention was attracted to the gall-bladder by a moderate amount of tenderness and rigidity in that region. The patient also stated that for at least a year he had been subject to attacks of pain beneath the right costal margin, which were severe enough to prevent him from attending to his professional duties. Acting upon this somewhat indefinite clew, Dr. J. N. Hall, seconded by Drs. Carlin, Whitney and Arneill, urged an exploratory operation, which I performed on May 22, 1915, assisted by Dr. W. S. Bagot.

The gall-bladder was found to be much elongated, slightly thickened and whitish, and adherent to the colon. It was filled with very thick, black bile, about the consistency of cold molasses. There were no stones. A moderate cirrhosis of the liver existed and there was much clear fluid in the peritoneal cavity, although

this had not been detected previously. The pancreas, stomach and appendix were negative. After draining off most of the ascitic fluid, a cholecystostomy was quickly done, the patient's condition not being favorable to further exploration.

Cultures, made by Dr. Phillip Hillkowitz from the thick, black bile, under vigorous aseptic precautions, gave a pure growth of the bacillus pyocyaneus, from which a vaccine was made, 8,000,000 to the c.c. This was administered every five days, beginning with 1/10 c.c. and increasing the amount 1/10 c.c. each dose until 1 c.c. was reached, where the dosage was maintained. (The fact that the pyocyanic germ develops its coloring matter in the presence of oxygen only sufficiently explains why the bile was black and not green.)

From the beginning of the use of the vaccine the general trend of the temperature was downward, although it occasionally went to a moderate height, especially following the injection of the vaccine. The physical condition, however, was still one of great weakness which seemed even to increase for a time in spite of the gradual subsidence of the fever; but after a few weeks decided improvement set in and the temperature slowly descended to normal. At the end of nearly eleven months from the beginning of the perplexing and discouraging disease recovery was complete.

During the eighth month a left-sided, clear pleural effusion appeared; but after a single aspiration the fluid did not re-accumulate, its behavior being analogous to that of the ascites which permanently disappeared following the operation.

At the present time, March 24, 1916, the patient is in most excellent physical condition, with the exception of a moderate weakness of the legs which causes some uncertainty in walking, but is slowly improving. (Dr. Delehanty reports that the extensor muscles are much weaker than the flexor, and that the patellar reflex is absent, while the plantar is present.) Both liver and spleen seem to be normal in size and there is no evidence of ascites.

The diagnosis in this case was based upon:

1. The acute onset, with vomiting and purging.
2. The characteristic eruption.
3. The long-continued fever for which no other cause could be found.
4. The severe pains in the extremities followed by paresis and muscular atrophy.
5. The detection of a pure culture of bacillus pyocyaneus in the bile, where it would be most apt to be found.
6. Recovery under drainage of the gall-bladder and the prolonged use of a vaccine. (The vaccine treatment was originally

## CHRONIC GENERAL PYOCYANEUS INFECTION

suggested by Charrin some thirty years ago and has since been used with apparent success—Groves, Barker).

7. The corroborative evidence of temporary ascites, cirrhosis of the liver and pleural effusion, which may all have been due to the pyocyanic infection and have been observed in similar cases. The most prominent point against the diagnosis was the absence of any marked hemorrhagic tendency, so frequently, but not always, found.

The features of especial interest in the case are:

1. Its extreme chronicity, having lasted nearly eleven months. Very few of these chronic cases have been reported. I have been able to find one by de la Camp (adult) lasting 18 months (death); one by Jadkewitsch lasting 4 months (adult) with paresis of both legs (recovery); one by Sudeck (adult) lasting 16 weeks (recovery); one by Hübener (adult) lasting 3 weeks; one by Kühn lasting 3 weeks (death); and one by Koslowski (adult) lasting 5 months (recovery).

2. The typical neuralgic pains followed by paresis and muscular atrophy. These have been frequently observed in both man and animals and are characteristic of the disease, but probably not pathognomonic, although so regarded by Charrin.

3. The absence of the bacillus pyocyaneus from the blood and its presence in the bile, which might be expected from the conditions under which it exists in the body. (The cutaneous eruptions and urine were not bacteriologically examined.)

4. The absence of any discoverable point of infection, unless it might be the teeth, making it possible that this was somewhere in the alimentary tract.

5. Recovery following drainage of the gall-bladder and the use of an autogenous vaccine.

6. The occurrence of cirrhosis of the liver. While this may have been due to other causes, it has nevertheless been observed in chronic pyocyanic infection (de la Camp), and seems to have disappeared since the recovery of the patient (Hall).

7. The presence of ascites and pleural effusion, which promptly disappeared, the former following an abdominal incision and the latter a single aspiration. Similar effusions from serous membranes, such as the pleura, peritoneum, pericardium, meninges and joints, have been reported by different observers.

8. The satisfactory recovery after so severe and protracted an illness, with the exception of a moderate paresis of the lower limbs, which seems to be improving.

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## A FURTHER NOTE ON ETIOLOGY OF SURGICAL SCARLATINA \*

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IN my note last year on the "Etiology of Post-operative or Wound Scarlet Fever" is recorded my belief that true scarlatina occurred sometimes by introduction of the infecting agent through a breach in the skin, instead of by the usual faucial or nasal route. My suggestion was that the reason no micro-organism had been proved to be the specific agent of infection was probably its ultramicroscopic size and filterable nature. I also suggested that the anginose affection termed scarlet fever might cover more than one specific infection.

Closer acquaintance with bacterial and protozoan causes of disease has recently proved the existence of infecting agents which produce a similar, but not identical, complex of symptoms, much to the confusion of medical nomenclature.

It is not difficult to accept the possibility of the scarlatinal infection reaching the blood of men through cutaneous wounds, if one recalls that tuberculosis and diphtheria sometimes present instances of this method of entrance; though scientific acquaintance with these morbid agents was recognized originally through diseases of the respiratory tract alone.

An exhaustive study by Alice Hamilton at the Memorial Institute for infectious diseases, in Chicago, about a dozen years ago, led her to the opinion that there was (1904) no convincing proof that the so-called surgical or wound scarlatina was anything more than typical scarlatina happening as a coincidence in a patient previously wounded. She believed that in many reported cases the condition was not scarlatina at all, but a septic process due to failure to maintain an aseptic course during the wound convalescence.

McCarty's paper published in 1914 records 43 post-operative eruptions in 1000 consecutive operations. After rejecting transient rashes, such as those due to general anæsthesia and those which appear within forty-eight hours, he studied the eruptions of sudden onset appearing three to seven days after operation and lasting from one to seven days. These had in his cases an average duration of four days. Those

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\* Read before the American Surgical Association, May 10, 1916.



beginning on the third or fourth day were the most severe and of the longest duration. In these there was no desquamation observed and in none were albuminuria or acetonuria found before or after operation; nor were casts detected in the urine in any patient in whom they were absent prior to operation.

McCarty thinks his cases show that post-operative eruptions are comparatively frequent, and that the underlying cause is a vasomotor disturbance probably due to irritation of the sympathetic nervous system. His late appearing eruptive group would seem to resemble many of the cases reported as surgical scarlatina.

It is probably true that sepsis or vasomotor influences are the cause of many cases of the so-called post-operative scarlet fever; and that many other instances of supposed infection through a cutaneous atrium are incidental infections in the ordinary way of non-immune persons, without relation to the existence of the prior cutaneous wound.

Several investigators have reported a discovery of the micro-organism which seemed to them scarlet fever's etiologic agent. The evidence, however, has not seemed conclusive to those competent to judge. The one most likely, according to expert opinion up to last year, is a streptococcus. There are so many varieties of streptococci, and differentiation thus far has been so difficult, that it is not improbable that the same organism may, alone or in association with other bacteria, be responsible for several clinical manifestations.

The pyogenic streptococcus, so familiar to surgeons, and that termed the streptococcus erysipelatis may perhaps be merely different strains of the same organism. Why may not that deemed to be responsible for the infection of scarlatina be the same or a close relation? Simple scarlatina is certainly a very different affair clinically from its so-called malignant form.

Clinicians see what seems to be an association of diphtheria and scarlatina in the same throat; the symptom-complex is in many cases attributed to a secondary streptococcus infection giving, with the evidences of the Klebs-Löffler bacillus infection, symptoms of streptococcus activity. Some anginose cases have been attributed, possibly incorrectly, to the affection called, by surgeons of an earlier period, erysipelas.

Is it not possible that palsy sometimes seen after scarlatina is due after all to the same etiologic agent that gives rise to the secondary palsy of diphtheria? Have not surgeons seen "erysipelas" more rife at the time of scarlatina epidemics? I think that I have, though my personal opinion is worthless. Indeed, the very term "erysipelas" should be abandoned as should "cancer"; but until the streptococcus

## ETIOLOGY OF SURGICAL SCARLATINA

family can be better discriminated it is perhaps as well to retain the former term as it may be to retain the latter until malignant disease can be etiologically understood. Rosenberger has informed me that the antitoxin of diphtheria has seemed to him to be curative in a streptococcus infection of the throat where no diphtheria bacilli were discovered. Webster Fox has used diphtheria antitoxin with apparent success in sympathetic inflammation of the eye.

Returning to the question of wound scarlatina I must refer to the experimental work of Strickler of New Jersey, who about twenty years ago inoculated children with saliva of scarlatina patients and produced what he believed to be scarlatina. He was endeavoring to reach a means of immunization. I do not defend his scientific ardor, but merely state that he thought he had produced scarlet fever by inoculation through the wounded skin. It is possible that the symptoms were those of sepsis, though I am inclined to think he really caused true scarlatina. There are a few cases reported that seem to have been definite instances of wound or surgical scarlatina. One was that of a German physician seemingly immune through many contacts with scarlatina in professional practice, who acquired the disease after wounding his hand during the autopsy of a patient dead from unquestioned scarlet fever.

Several recent etiologic studies have been reported by investigators as holding out hope of the discovery of the organism causing scarlet fever. The latest, so far as I know, is that of F. B. Mallory and E. M. Medlar of Boston, detailed in the *Journal of Medical Research*, March, 1916. The work was done in the Pathological Laboratory of the Boston City Hospital. This Gram-positive bacillus, which is more decidedly Gram-positive than the diphtheria bacillus, is described and thought by them to be a true bacillus scarlatinæ. The coincident streptococcus infection often complicated the investigation. Mallory, years ago, thought the cause of scarlet fever to be protozoan; his interest in the subject continuing all these years seems to me to add force to the probable accuracy of his present investigation and the value of his opinions.

# MELANOTIC CANCER\*

WITH A REPORT OF 91 CASES

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MELANOTIC sarcoma, or melanoma, one of the most common varieties of malignant tumors, was first described as occurring in horses, in the latter part of the eighteenth century (Bruguorne in 1784 and Latournelle in 1809). Laennec was the first to write about this type of tumor in man. In 1806 Laennec and Bayle published a report of cases of melanotic tumors of the lungs and other organs. Laennec regarded these tumors as accidental productions, representing one of the varieties of cancer, and divided them into four classes: (1) Tumor masses encased in cysts; (2) non-encapsulated tumor masses; (3) tumor masses infiltrating the tissues of an organ; (4) masses deposited upon the surface of an organ.

This rather artificial classification obtained for a long time, and for a number of years our knowledge of these tumors advanced but little, except for the study of veterinary surgeons, which showed that they usually occurred in animals with white skin, and that the condition was hereditary and capable of transmission from one generation to another.

The discussion as to the origin of these tumors from fibrous tissue or epithelium has been going on for a long time, and has not as yet been entirely settled. We know very little about the origin of malignant tumors and this is especially true of melanotic tumors. As far as our present knowledge goes, there is little evidence of heredity in this type in man. The great majority of melanotic sarcomas, aside from those in the eye or orbit, develop from congenital moles or pigmented warts; but there are some important exceptions which will be mentioned in the paragraph on primary site of the disease.

Trauma in the form of local injury, or more especially of repeated irritation, plays a very important part in the etiology of this group of

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\* Read before the American Surgical Association, May 10, 1916.

tumors. The effect of trauma has long been noted, Busch having called attention to it many years ago, and reported specific examples as far back as 1880 (*Berl. Klin. Wochenschr.*, 1880, No. xvi), and in our series of cases reported here, there are several cases which confirm the truth of this theory.

We believe that melanotic neoplasms are probably of an infectious nature; that they are due to some extrinsic cause, *e.g.*, some specific micro-organism or virus, which finds in the congenital mole that has been irritated or injured the most favorable conditions for development. We do not believe that the pigment or melanin is the sole cause of the proliferation of the cells, as held by some writers, but rather, that some micro-organism excites the cells to the production of the characteristic pigment.

Recently published observations on the "Etiology of Sarcoma in the Rat," by Albert S. Leyton (Prof. of Pathology, University of Leeds) and Helen G. Leyton, lend support to this theory. While it was hitherto known that certain sarcomata in animals, as, for instance, the chicken sarcoma (Peyton Rous) had a filterable virus capable of producing the disease by inoculation, it remained for the Leytons to prove that the same is true of rat sarcoma. Their experiments were carried out as follows: An emulsion of sarcoma was passed through a Chamberland filter and eighteen rats were inoculated with this filtrate. In four, a tumor exactly similar to the original spindle-celled sarcoma developed. They hold that the active cause of this rat sarcoma is a streptothrix, and while it may not be possible for this organism to pass through a Chamberland filter, it produces spores which do pass through. They also add, in order to test the relationship of the streptothrix to the formation of sarcoma, several rats were fed with it weekly for some time; so far, a tumor has resulted in one of the fed rats only. In the mediastinum was a growth about the size of a cherry, together with several smaller ones, which had all the characters of a spindle-celled sarcoma and was inoculable.

At present the most uncompromising opponents of the theory of the microbic origin of cancer are willing to concede that not only Hodgkin's disease, but lymphosarcomas as well, are of infectious origin. We believe that possibly in the future, other groups of malignant tumors may be taken out of the general group of "cancer" and placed in the same category as "infectious granulomata."

The experimental production of tumors in plants by inoculation of a specific bacterium, by Dr. Erwin F. Smith (Bureau of Plant Pathology, Washington, D. C.), is, we believe, of extreme importance and may

have a bearing upon the question of the etiology of human tumors. These tumors in histological structure and metastases furnish a striking analogy to malignant tumors in animals and in man. The most remarkable feature of these tumors is the fact that it has been found possible to produce the different types from the same micro-organism by simply varying the site and depth of inoculation. One type of tumor that the opponents of the parasitic theory of tumors have always regarded as impossible to explain on the basis of any other theory but that of Cohnheim has been the teratoma. Yet very recently Dr. Smith has demonstrated that he could also produce a typical teratoma or embryoma in plants by simply inoculating the organism at the site of a latent bud between the leaf and the stalk. The results of these experiments he has just reported in a paper read before the American Cancer Research Society, May 7, 1916. He also showed numerous examples of these tumors growing in plants, in the Bureau of Plant Pathology. Of course it is possible to deny any analogy between tumors in plants and tumors in man, but no one can examine these tumors microscopically and study their development in the plant itself, without being deeply impressed with the possibility of such analogy.

Becheaux (Paris Thesis, 1908-1909) in discussing the contagiousness of malignant melanotic tumors states that for a long time efforts have been made to ascertain whether they were contagious and inoculable.

Goujon injected fresh material from melanotic tumors in man under the skin of different animals, with the result that within a certain time the disease developed and became generalized in all of the animals.

Klerck was able to produce melanotic tumors in one horse and then another, by inoculation. Eiselt observed a hostler who contracted the disease while taking care of horses suffering from melanotic tumors. Later, Queyrat inoculated two monkeys, one under the peritoneum, and the other under the skin, with fragments of melanotic sarcoma. The inoculations gave positive results and the animals died of the disease at the end of two and two and one-half months, respectively. Other experimenters have also been able to obtain positive results from inoculation.

Becheaux believes that these facts are sufficient to give a serious point to the theory of Bard, who believes in the existence of a special form of micro-organism which is the cause of melanotic sarcoma.

In connection with Case XIV we would state that in 1895, Dr. B. H. Buxton (late Prof. of Experimental Pathology, Cornell University Medical College) and one of the writers (Coley) experimented with inoculations of melanotic sarcoma in rabbits. Numerous small subcutaneous melanotic tumors were removed from the above case, and under strict aseptic precautions were ground up and inoculated into the peritoneum in three rabbits. The latter were also fed upon pulverized

portions of tumor spread upon lettuce leaves. Within three months all of the rabbits died, and in each case the liver was found to be filled with multiple tumors, the pathology of which was uncertain; they were grayish-white in appearance with no pigmented areas, and varied in size from one-eighth to one-half inch in diameter. It could not positively be determined whether they developed as a result of the inoculation, or whether they were examples of independent coccidial disease. They were not regarded as true tumors by the pathologist who examined the specimen.

In one of our most recent cases (Case XXIV) a series of inoculations was carried out by Dr. Richard Weil, with entirely negative results.

Pathologically all melanosarcomata are characterized by the fact that they contain a pigment, brown or black in color, which is a product of cell metabolism and which usually contains no iron. This melanin is found in the cells themselves or in the intercellular substance, and usually is present in the form of granular matter. The tumor itself is made up of cells which may be round, spindle-shaped, quite irregular in outline, or very large in size (giant-cells). In many of these tumors there is a tendency for the cells to assume an alveolar arrangement. Whether in this type of tumor the cells are of epithelial or connective-tissue origin has not as yet been entirely settled.

Müller regarded melanotic tumors as carcinomas; Lebert as simple cancer. Stromeyer was the first to term them melanotic sarcomata, and later on, Virchow established the existence and frequency of such tumors and regarded the majority as sarcoma, but also recognized cases of carcinoma. Johnston, in his paper in the *Journal of Cutaneous Disease*, 1905, says:

Aside from the natural division into choroid and skin tumors, melanotic neoplasms, which from their diversity of origin are best called melanomas, show several varieties:

1. The commonest and therefore most important is that derived from soft nævi which are endotheliomas of lymph-vessel origin.
2. A second variety exists with the same histologic picture which does not spring from nævi and whose origin is directly traceable to endothelioma, probably also lymphatic. These tumors are probably primary in the lymphatic vessels or glands.
3. The third division is truly epithelial in origin. These tumors are of various types and show only a very slight tendency to malignancy, a fact sufficient in itself to determine a cardinal difference from the melano-endotheliomas, whose capacity in this connection can hardly be exaggerated.

The majority of investigators now believe that these tumors are of ectodermal origin. A very strong point in the determination of the

kind of cells that these tumors spring from is the pigment formation. Wieting and Hamdi (*Beitr. z. Path. Anatomie*, 1907, vol. xlii) say that they consider pigmentation around ulcers the result of chronic irritation which, according to the manner and the place of irritation, leads to increased production of corneous substance, or proliferation of the epithelium, or to over-production of pigment. The pigmentation due to the Röntgen rays and the sunlight must be explained in the same manner. It is probable that melanotic tumors arise from epithelial cells which, as a result of limited embryonal malformation as regards function, possess exceptional pigment-forming qualities, which are increased by the abnormal proliferation. They hold that excessive production of pigment is an expression of pathologically increased function of the cell, which ends with its death; and investigation as to normal and pathological pigmentation forces them to recognize only an epithelial pigment formation.

Borst (*die Lehre v. d. Geschwol.*) says that all melanoblastomas occurring in the realm of the ectoderm can easily be explained genetically. He also says that he does not hesitate to credit the entodermal epithelium with the capacity to form pigment.

Mallory classes melanomas as sarcomas and believes they originate from connective-tissue cells.

A careful study of the most important literature on the subject shows that at present it is impossible to formulate any definite accepted classification, based upon the histological structure, and the report of a case by Leo (*Société de Chir. de Paris*, 1912, 1007) illustrates the difficulties in this connection. His case, clinically, resembles very closely the ordinary type of so-called melanotic sarcoma. The histological structure was very carefully studied by Dr. Herrenschmidt, who stated that nothing in the architecture of the neoplasm or in the morphology of the melanin-bearing cells permitted one to state positively that it was a sarcoma or an epithelioma. Certain features of the case would justify one in calling it an alveolar melanotic sarcoma, and other points would quite as well justify one in calling it "*atypique melanome epitheliome*." For those who preferred to reserve their opinion on the histology of the tumor, he suggested calling it a "*melanome congenital atypique*."

Our own cases seem to justify the view that certain melanotic tumors are apparently of connective-tissue origin and might properly be called melanotic sarcoma. Other cases are equally as clearly of epithelial origin, and in certain other cases, like Leo's, it is almost impossible to determine in which type of cell the tumor originated.

## MELANOTIC CANCER

Possibly the most rational method of dealing with these cases is to classify them all as malignant melanomas or melanotic cancer, without attempting too closely to determine the exact point of origin.

W. Sampson Handley, author of the "Hunterian Lectures on Melanotic New-growths" (*Lancet*, 1907, 927-996), although originally of the opinion that these tumors were of epithelial origin, after a most careful study is now strongly of the belief that practically all melanotic new-growths are of connective-tissue origin. This view is also held by Ribbert who has also made a most thorough study of the subject.

Eve, basing his views chiefly on clinical observations, holds that these tumors are practically all of epithelial origin, and points out many clinical features in which they resemble carcinoma.

Chalier and Bonnet say that primary melanosarcomas of the rectum originate in the endothelial spaces of the submucosa, infiltrating both into the muscularis and the mucosa, breaking through the latter and ulcerating. The whole process probably arises from the inclusion of epithelial cells; hence these authors conclude that these tumors are epitheliomata of the malpighian or ectodermal type arising in the anal region from malpighian epithelium.

At the present time, opinions are of such wide diversity that it is impossible to express any positive view as to the classification of melanotic new-growths. From our own observations, we are inclined to the belief that there is a measure of truth in both theories. The majority of tumors are probably of connective-tissue origin, while a certain number are epithelial.

The life history of these tumors is very variable. In the great majority of cases a pigmented mole is the starting point of the disease. This mole may have been present for years without undergoing any change, but it gradually begins to ulcerate, its base becomes indurated or slightly elevated, and it may increase slightly in size. Within a very short time the nearest glands become swollen and increase fairly rapidly in size. The skin over the glands may become bluish-black in color and finally its surface may ulcerate, allowing the discharge of characteristic bluish-black material. In many cases the glands in the neighborhood do not enlarge very much or very rapidly, but a large number of nodules are found all over the body under the skin. Metastases may occur in the internal organs, lungs, liver, spleen, kidneys, and the brain. Hand in hand with the appearance of metastases, there is a rather slow progressing loss of strength and weight, together with an ever increasing anæmia.

When the primary tumor has been in the eye, the favorite site for



metastases is the liver. The involvement of this organ may occur years after the enucleation of the eye or may appear almost immediately. In these cases the other organs are involved shortly after the liver, and subcutaneous tumors appear also. In many cases metastases, whether lymphatic, internal, or subcutaneous, may occur when the original tumor is of such small size that the patient does not even consult a physician about it. There is also the class of cases which, on account of our inability to find a primary focus, we are forced to call primary in the lymphatic system. As will be seen from our list of cases, most of these are in the cervical glands and seem to be of an especially malignant character, causing death in a short time.

The manner of extension of melanotic neoplasms beyond the primary focus of the disease differs somewhat from that observed in other types of cancer. This extension has been very clearly described by Sampson Handley, *loc. cit.* There is no reason to doubt the characteristics in melanotic tumors, which, he states, usually extend in two ways: First by the permeation method (already described by Handley in reference to carcinoma of the breast), that is, a centripetal distention into the lymph-vessels and spaces covering the deep fascial planes; second, the involvement of the vessels, usually the neighboring veins, with the destruction of the walls of the vessels; the formation of thrombi which later permit the escape of small emboli which spread the disease to all parts of the body, most frequently the liver and the lungs.

A few cases have been reported in which marked spontaneous regression of melanotic growths has taken place. In all of these cases, we believe, this regression has proven only temporary. The most remarkable case is that of Sir Alfred Pearce Gould, reported by Handley, *loc. cit.*: A very large number of subcutaneous melanomata disappeared in the course of a few months, but the patient later died of internal metastases. It is only fair to state, that the patient during this period was taking a preparation of Venetian turpentine and sulphur.

The duration of life in our cases was found to be very variable. The most malignant tumor we have in our series was one which appeared in the axillary glands, causing the death of the patient in one month from the time of its appearance. We also find a case where death occurred in nine months, and in another in eighteen months. The majority of cases last from two to three years, but we have several cases which lasted from eight to ten years.

While nearly all of the text-books and authorities on cancer state that malignant tumors of the melanotic type are primary in the skin.

## MELANOTIC CANCER

the matrix of the nail, or the eye, careful investigation shows that in a small group of cases the tumor originates at other sites and in other structures.

Eberman of Petrograd (*Deut. Zeit. f. Chir.*, 1896) reports 30 cases of melanoma, 4 of which were primary in the rectum, and 2 in the lymphatic glands.

Wieting and Hamdi (*loc. cit.*) report a large number of such cases with specific references. Among these are: Melanosarcoma of the intestine by Treves; of the liver by Fredrichs and v. Block; of the rectum, by Wiener; of the uterus, by Williams; of the bladder, by Thompson; of a subaxillary lymph-node, by Cecca; of the bone-marrow, by Rindfleisch; of the mammary gland, by Langenbeck; of the œsophagus, by Baur, as well as a number of others.

Chalier and Bonnet in the *Revue de Chirurgie*, 1914, reported a large number of cases in which the disease was primary in the rectum.

Eve states there is one case on record of a primary melanoma of the spinal cord. We have in our own series a case of melanosarcoma of the rectum, one of the breast, and five cases in which the tumor was apparently primary in the lymphatic glands. In these cases no other site of origin could be found during the course of the disease; but it is only fair to state that no autopsy was made in these cases. Eve cites one case in which autopsy failed to reveal any other focus of the disease, until at the end, the last portion of the rectum was examined and a small melanotic tumor was found, situated a short distance from the anus.

The prognosis of melanotic tumors has been regarded almost universally as hopeless. Boulay (*Archives Générales de Médecine*, July, 1888) has made an exhaustive study of the prognosis in this variety of tumors. He states that Dupuytren laid down the principle, that operation is contra-indicated in melanotic cancer, and Velpeau, Cruveilhier, and Virchow express the same views with regard to the prognosis of these tumors. From their statistics, as well as those of Cornil and Trasbot, conclusion is drawn that the prognosis of melanotic tumors is fatal, and that the patient is better without surgical intervention. The reason against operation is the fact that the disease remains local for such a short time, usually becoming generalized before surgical operation is considered.

In spite of the opinion of these distinguished authorities, Boulay believed that a large number of cases will be found in which operation has been performed successfully, and a study of which ought to throw some light upon the question of the value of surgical intervention.

Boulay states that the dangers of surgical intervention did not seem to have much effect in arresting the hands of the surgeons. It appears, on the contrary, that the well-known malignancy of these tumors when left to themselves, has, in a way, influenced the surgeon to make as complete an extirpation as possible.

Dietrich, in *Langenbeck's Archiv*, for 1887, expressed the ideas of his superior, Czerny, in advising a wide extirpation of melanotic tumors, the only

contra-indication to this procedure being cachexia. He believed that the advantages of the operation were: a favorable influence upon pain and hemorrhage and, in certain cases, prolongation of life, if nothing more.

By a careful study of the cases reported between 1880 and 1888, in which surgical operation was performed, Boulay attempts to settle the question of the wisdom of surgical intervention. He divides his statistics into cases subjected to surgical intervention and those in which no operation was performed. In his series of 191 cases, in which an abstract of the patient's history is given, we find that 152 were operated upon and 39 cases were treated without operation. In the foregoing number of cases operated upon, no data regarding the late results are given in 37 cases. As regards the remaining 36 cases mentioned as having survived the operation, recurrence or generalization of the disease took place shortly after; the remaining 19 cases were free from local or general recurrence, and reported as having been cured.

Boulay divides his series into three groups, the first, showing the interval which elapsed between the date of operation and the time of recurrence, viz.:

Less than 2 months .....	11 cases
From 2 to 6 months .....	12 cases
From 6 to 12 months .....	6 cases
From 12 to 15 months .....	3 cases

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32 cases

Second group, showing the period which elapsed between the operation and death:

Fifteen days and less .....	12 cases
From 15 days to 1 month .....	4 cases
From 1 to 6 months .....	17 cases
From 6 to 12 months .....	7 cases
From 1 to 2 years .....	1 case
From 2 to 3 years .....	1 case
Ten years .....	1 case

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43 cases

In the above group, 40 died after a period of one year from the time of operation. The average duration of the disease before operation was 6 to 7 months. In 15 cases the operation was supposed to have been followed by a cure.

The more important question now arises as to how long a period after operation a patient suffering from a melanotic tumor must remain free from recurrence before being regarded as a cure. Three years' freedom from the disease has generally been considered by the profession as a sufficient period after which to justify classifying the case as a cure. One of the cases cited by Boulay remained well for ten years after operation, and finally died from generalization of a melanotic sarcoma, and in two cases cited by Eve (both of the eye) recurrence took place after 5 and 10 years, respectively.

In 19 of Boulay's cases, which had remained well, the period of observation is given as follows:

## MELANOTIC CANCER

4 days .....	1 case
7 days .....	1 case
5 months .....	2 cases
1 year .....	3 cases
1 year, 2½ months .....	1 case
2½ years .....	1 case
3 years .....	2 cases
4 years .....	1 case
4½ years .....	2 cases
5 years .....	1 case
5½ years .....	1 case
9 years .....	1 case
12 years .....	1 case
Unknown .....	1 case

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19 cases

Accepting the three-year standard, we have 9 cases of the entire series that can be classified as "cures" after operation.

Boulay believes that in many cases the disease is primary in the viscera and that the external tumor which causes the patient to consult a surgeon is really a secondary affair.

In conclusion, Boulay states that in this present series of cases, permanent cures, or at least successes, have been obtained by a wide extirpation of the primary disease—although the number has been comparatively small. On the other hand, he believes that in many cases surgical intervention has not only been useless, but distinctly harmful, the life of the patient having been decidedly shortened as if a violent stimulus to the activity of the disease had been given. He concludes that the question of the curability of melanotic tumors has made no progress, but if one decides on surgical intervention, one must reject everything in the way of half-measures—cauteries and ligatures should never be used, but as complete an extirpation as possible should be done.

*Treatment.*—So far as treatment is concerned, by far the most important question is that of prophylactic treatment. Inasmuch as the great majority of melanomas have their origin in a pigmented mole that has undergone either chronic irritation or is the site of a recent trauma, it would seem rational to advise the removal of all moles, particularly those that have been injured, or are located in exposed portions of the body.

We believe it very important to choose the best method of removal of such moles, for in many cases in our own experience, the injudicious methods of removal have apparently been the exciting cause of the melanoma. This particularly refers to the method of removal with silk ligature, electric cautery, or liquid air. Free excision with the knife, including a portion of the underlying skin and fascia, is, we believe, the best and safest method of procedure. It is possible that

the mole can be easily and quickly removed by single doses of radium, but whether or not the irritation caused by the radium might be a predisposing cause in the development of a melanoma is a question on which we have not sufficient data to make it possible to answer at the present time. Personally, we believe the use of radium or X-rays in a pigmented mole or in an operable melanoma a most unwise procedure and attended with grave risks.

Unfortunately, the surgeon rarely sees a primary melanoma at a period when surgery might offer some hope of a permanent cure. In the early stages of the disease, when the mole has begun to show signs of irritation or ulceration, the patient first consults the family physician who, because of the rarity of the condition, fails to appreciate its gravity, and either ties off the mole with a silk ligature or applies some caustic, like nitrate of silver or liquid air, which only increases the irritation and hastens its transformation into a highly malignant tumor. It is only when the disease begins to recur locally or systemically, that the patient is referred to a surgeon, and at this stage surgery can accomplish little or nothing in the way of a permanent cure.

If the disease is seen in the early stage, the method of operation advocated by W. Sampson Handley of London (in 1909) is undoubtedly the best: Excision of the tumor together with a very wide margin of the skin, including all of the underlying fascia, and a careful dissection of the nearest lymph-glands whether they are palpably enlarged or not.

For many years, the X-rays have been tried in a number of cases of this type of malignant tumor, at the Memorial Hospital. In some, marked inhibition of the growth followed, but the improvement was only temporary and after a few months (in one case a year) the disease ran its course.

As far as known, no very large number of melanomas have been treated with radium; certainly but a few with large doses of radium. One case at the Memorial Hospital (treated by Dr. Janeway), a melanoma apparently starting in the nasal cavity and involving the antrum, showed marked improvement under the combined treatment of ligature of the external carotid, followed by a course of radium treatment. The disease was almost completely controlled for several weeks, but then began to progress rapidly, causing death a few months later; no autopsy was obtained.

The mixed toxins of erysipelas and bacillus prodigiosus have been tried in 21 cases of inoperable melanotic growths by one of the writers. In not a single case, however, has a permanent cure been obtained unless such can be claimed in the case later described in detail, in which

## MELANOTIC CANCER

the toxins were used for a supposed recurrence after operation, and in which the patient has remained well up to the present time, six years later. In this case there is considerable doubt as to whether the condition found at the time was a recurrence or not.

On the other hand, it should be stated that marked retardation of the disease in a number of cases in which the toxins were used has been observed, and more important still, that in four authentic cases undoubted recurrent and inoperable melanotic malignant tumors have disappeared under the injections of erysipelas and bacillus prodigiosus without other treatment. In two of these cases, the first treated by Dr. Greenwood of Leeds, England (*Lancet*, January, 1912), the patient is still well, upwards of five years, and in another, treated by Dr. Howard Lilienthal of New York, the patient is now well over ten years after. In the third case, that of Dr. Bunts of Cleveland, Ohio, disappearance of the tumor took place under the use of the toxins, but the patient died of metastases in the brain, nine months later (no local recurrence).

In the fourth case, Dr. Geo. R. Fowler's, the patient remained well two years, then had a recurrence which proved fatal.

These cases are too few to offer much hope of a cure of inoperable melanoma, yet they furnish sufficient evidence of the inhibitory action of the toxins, in our opinion, to justify a routine method of treatment with the toxins in all cases after primary operation, in the hope of lessening the number of recurrences.

The case treated by Dr. Howard Lilienthal of New York, is perhaps the most important of all, showing the curative value of the toxins in this type.

CASE I.—This case was first reported by Dr. Lilienthal in the *ANNALS OF SURGERY* (1903, vol. xxxvii, p. 440), who stated that the tumor started in the region of the seventh rib, and extended so that it involved a considerable portion of the eighth rib as well. An attempt at surgical removal was made on November 15, 1901, at which time the whole seventh rib, together with a considerable portion of the eighth, was removed. The pleura was involved to such an extent that no attempt at radical operation was made, and the wound was closed with drainage. Shortly after, the tumor reappeared in the line of the cicatrix, and the patient's general condition markedly declined. At this time the patient was put upon the mixed toxins of erysipelas and bacillus prodigiosus (Coley). The initial dose was one-half minim, which was gradually increased up to five minims, which produced a severe reaction. The treatment was kept up for eight weeks. Almost immediately

after the first few injections, the tumor began to decrease in size, and his general health showed signs of improvement. By the time the treatment was discontinued, the tumor had entirely disappeared and the patient had completely recovered his normal health. He is in good health at the present time, fifteen years later.

A specimen of the portion removed was submitted to Dr. F. S. Mandlebaum (Pathologist, Mt. Sinai Hospital), who reported that "the tumor is a pigmented sarcoma of the mixed fibromatous type; the prominent feature of the tumor is the infiltration of the sarcomatous tissue with pigmented cells."

CASE II.—Greenwood. This case has already been published in the "*Lancet*" of January 19, 1912, p. 25, but it is so important, that it is worthy of brief reference, to which we are able to add the subsequent history of the case.

Mr. J. B. was operated upon for melanotic sarcoma of the neck in February, 1911. The operation was incomplete. The tumor recurred almost immediately and grew rapidly. By March 3, 1911, when the toxins were begun, it was  $2\frac{1}{2} \times 2$  inches in size. The initial dose was  $\frac{1}{2}$  minim, which was gradually increased up to 10 minims. He received 36 injections from March 13 to July 11, all of which were made in the neighborhood of the tumor. Immediate improvement was noted which continued until July 11, when no trace of the disease remained. According to my advice the injections were continued until April, 1913, or a period of two years and one month, during which time he received 105 treatments. The highest dose was 15 minims. The microscopical diagnosis of the tumor removed at operation was melanotic sarcoma.

In a letter dated July 16, 1913, Dr. Greenwood states:

"Mr. B. is in splendid health, doing full work, and now weighs 12 pounds more than in 1911. The site of the tumor is marked by a hollow covered by clean scar, with no trace of pigment."

In a letter dated April 14, 1916, Dr. Greenwood states:

"Mr. B., the case of melanotic sarcoma treated with your toxins in 1911, remains absolutely free from any recurrence and enjoys excellent health."

This case is so remarkable that it is important to be sure that there was no error in diagnosis. With reference to this Dr. Greenwood states:

"The report of the pathologist was so precise, and the clinical features so unmistakable that the patient's life was quite despaired of, and there was neither tumor nor slide kept—it is a pity. The treatment was only used (without faith) to convince the relatives that every means had been tried."

I believe that the good result in this case was partly due to the

## MELANOTIC CANCER

long period (two years) over which the toxins were continued.

CASE III.—The history of the third case I owe to the courtesy of Dr. Frank E. Bunts of Cleveland: E. C., male, aged fifty-one years. Family history negative. In April, 1912, he noticed a small nodule on the plantar surface of the small toe on the left foot. February, 1913, the toe was amputated. Diagnosis: Angio-melanosarcoma. During the summer of 1913 he noticed a nodule on the upper surface of the next toe. Second operation November 4, 1913. The toe was amputated with several other nodules in the foot. Two weeks before the second operation he had noticed two lumps in the left groin. Ten days later these were removed, followed by X-ray treatment of the groin up to the time of the third admission, October 24, 1914. Operation October 24: Inky black fluid drained from groin.

*Microscopic Diagnosis.*—Melanosarcoma.

The growth in the groin became larger in spite of X-ray treatment and the leg became hard and swollen, so that the thigh was at least one-half again the size of the opposite one. The wound in the groin had not healed over, but was filled with a black fungoid mass. Dr. Bunts adds that he had considerable difficulty in securing the toxins from the manufacturer, as they had to make them up fresh, and after the exhaustion of the first amount received, three weeks intervened before he could get some more. The injections were begun January 19 and given as follows:

First injection .....	½	minim
Second injection .....	1	minim
Third injection .....	2	minims
Fourth injection .....	4	minims
Fifth injection .....	6	minims
Sixth injection .....	9	minims
Seventh injection .....	13	minims
Eighth injection .....	13	minims
Ninth injection .....	15	minims
Tenth injection .....	16	minims
Interval of three weeks.		
Eleventh injection .....	6	minims
Twelfth injection .....	14	minims
Thirteenth injection .....	19	minims
Fourteenth injection .....	22	minims
Fifteenth injection .....	23	minims

Dr. Bunts states:

Improvement in the local condition became evident in about a week or ten days after the beginning of the injections. The patient was discharged on March 8, 1915, with the swelling in the thigh practically all



gone and the wound in the groin healed over with the exception of an area of perhaps  $\frac{1}{4}$  inch in diameter. This had subsequently healed when I saw him on May 21. At this time there was no evidence of a recurrence of the growth.

It is important to note the rapid increase in the dose as shown by Dr. Bunts' records. We are inclined to believe that the great improvement in this most unpromising case is probably due to this very increase in dosage, much more rapid than we have generally considered to be safe. Instead of increasing by  $\frac{1}{2}$  minim each time, the dose was increased, in some cases, by 3 to 4 minims, and in one instance by 8 minims.

In spite of this favorable immediate result, the patient died in December, 1915, of what was regarded and believed to be cerebral metastases, but without local recurrence, as Dr. Bunts just informed us.

The only favorable results (not cures) that have been personally obtained with the toxins in melanotic sarcoma, were observed in the following three cases, the first of which has some similarity to the case of Dr. Bunts.

CASE IV.—E. R. D.,<sup>1</sup> male, fifty-three years of age, was referred to Dr. Coley by Dr. W. J. Mayo on February 20, 1912, with the history that 3 to 4 years ago he had noticed a mole on the left fourth toe. Two years and nine months ago it had been removed by operation. Two months before, he had noticed an enlarged gland in the groin. This grew with great rapidity and was removed at the Mayo Clinic in the early part of February, 1912. The report of the microscopical examination made by Dr. L. B. Wilson reads as follows:

The tumor is a pigmented sarcoma composed of medium-sized round-cells and oval epithelial-like cells, the latter in many areas presenting an alveolar arrangement. Without entering into the question as to whether these tumors are epitheliomata or sarcomata, there seems to me no doubt that this tumor was a metastasis from the neoplastic change in the pigmented mole previously removed from the fourth toe of the patient's left foot.

The operation was incomplete and the patient was referred to me by Dr. Mayo for the toxin treatment. Physical examination at this time showed in the left groin a partly ulcerated mass of the

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<sup>1</sup> This case has been reported in full in the Transactions of the Third International Conference of Cancer Research at Brussels, August 1-5, 1913.

## MELANOTIC CANCER

appearance and consistence of melanosarcoma,  $2 \times 3$  inches in diameter. At the end of one month's treatment the tumor had entirely disappeared and the wound had healed. The patient died on October 20, 1912, apparently from metastases in the right hemisphere of the brain—again closely resembling the case of Dr. Bunts.

The following case is reported in some detail, for the reason that it is one of two cases of our series in which the patient lived more than three years after operation. Whether or not the mixed toxins of erysipelas and bacillus prodigiosus (which were given as a prophylactic after primary operation, for nearly two years) were a factor in preventing or delaying a return of the disease, is a question that can never be answered with certainty.

CASE V.—Miss A., aged seventeen years, family history negative, was referred to me by Dr. Stuart McGuire of Richmond, Va., in May, 1912, with the following history:

In the early part of 1912, patient first noticed a small tumor in the upper and outer aspect of the thigh, which steadily increased in size until it had reached the size of a hen's egg. Dr. McGuire states that on April 30, 1912, under general anæsthesia, he excised the growth by an elliptical incision, going well outside the indurated area. The tumor did not extend to the fascia and was removed very completely. Microscopical examination showed it to be a melanotic sarcoma with a very few pigment cells.

*Physical examination*, by Dr. Coley, May 17, 1912, showed a recent cicatrix in the upper anterior portion of the left thigh, seven inches long. No enlargement of the glands in the groin, no swelling in the region of the wound. The toxins were begun on May 17;  $\frac{1}{2}$  minim produced a considerable reaction. The patient proved very susceptible and it was impossible to increase the dose more rapidly than by  $\frac{1}{4}$  minim, which caused a severe chill and temperature of  $103^{\circ}$ . The patient returned home shortly after, where the toxins were continued by the family physician, Dr. R. C. Fravel, of Richmond, Va. The treatment was carried on for nearly two years, during which time she received upwards of one hundred injections.

A letter dated April, 1916, states that the patient is still well and free from recurrence after four years.

CASE VI.—Case of Dr. T. S. McDermott,<sup>2</sup> New Haven, Conn. A brief abstract of the case is as follows:

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<sup>2</sup> For full details see paper by Coley on "A Report of Recent Cases of Inoperable Sarcoma Treated with Mixed Toxins of Erysipelas and Bacillus Prodigiosus," reprinted from Surg., Gynæcol. and Obstet., August, 1911.

Female, adult, was operated upon for sarcoma of choroid, December, 1904, at Boston City Hospital, the eye being enucleated. She remained well for two years, when a small growth was noticed in the scar in the orbital cavity. An incomplete operation was performed by Dr. McDermott in November, 1906. On November 24 the mixed toxins were started and continued under Dr. Coley's direction for four months. The patient remained well for a little over three years, when she developed internal metastasis, causing death five months later.

CASE VII.—S. H., male, aged forty-two years. About ten years before patient first noticed a pigmented mole on the outer calf of the right leg, which remained about the same size until the spring of 1909, when it became irritated by his clothing, and frequently bled. Shortly after this it began to increase somewhat in size, and the patient consulted me in September, 1909. I advised an excision including a wide area of skin together with the underlying fascia, which was done by my associate, Dr. Wm. A. Downes. The tumor was examined by Dr. Wm. C. Clark (Pathologist of the Memorial Hospital) who pronounced it basal-celled epithelioma, pigmented.

The patient remained well for a little over a year, when he developed enlargement of the inguinal glands with œdema of the leg and thigh. At about the same time he began to have râles in the chest. He was treated by his physician, Dr. H. A. Griffin, and was frequently seen by Dr. Downes and myself. We believed the patient was suffering from metastases of the old trouble, and regarded the condition as hopeless. After six weeks, the chest symptoms cleared up, his general condition improved, and he was then put upon the mixed toxins of erysipelas and bacillus prodigiosus. The treatment was administered in small doses, and kept up, with occasional intervals of rest, for about a year. The swelling in the groin subsided and the œdema disappeared. It is quite possible that we were all mistaken in believing that he had metastases, and that the condition was due to some other cause. At any rate, the patient has remained well up to the present time, seven years later.

If the freedom from recurrence was due to surgery alone, it is the only case in our series apparently cured by surgery.

*Pathological Report.*—Specimen shows the structure of a basal-cell carcinoma of the skin. The tumor consists of one large convoluted mass of small cubical cells of the type of basal epidermal cells. In some of the cell groups there are small foci of adult squamous cells. About the main tumor mass, which measures about  $\frac{1}{2}$  cm. in diameter and lies well beneath the epidermis, there are a few outlying large cell groups in which the central cells are pigmented. At one point the skin is ulcerated and the adjacent

## MELANOTIC CANCER.

tumor structure is disordered. Here there is a large collection of heavily pigmented cells. Whether this pigment gives the hemosiderin test and is the result of hemorrhage cannot be told without a special stain. It may be a basal-cell carcinoma of the skin with secondary pigmentation from hemorrhage. It is not a typical melanoma.

Our personal series of cases shows that the disease was apparently primary in the testis in one case, recurrent in one case, in the upper jaw in one case, in the glands of the neck in five cases.

CASE VIII.—*Melanotic sarcoma apparently primary in the testis.* G. S., male, twenty-nine years old. Family history good. No mole was present in this case. The patient had always been in good health until August, 1896, when he fell from a bicycle, injuring the left testicle. About two weeks later a tumor appeared in the left testicle at the site of the injury, and grew very rapidly. First operation on January 13, 1897, by Dr. Milbank, of Albany, who removed the testicle. A recurrence quickly developed in the cord and inguinal glands. On September 30, 1897, Dr. Coley operated, removing a large lobulated mass situated in the inguinal and iliac region. Each portion was surrounded by a capsule and extended down to the aponeurosis and external oblique, but did not enter the inguinal canal. To the right, it extended beyond the median line, tipping under the lower border of the symphysis pubis, almost entering the pelvis from below. The tumor was of a dark-bluish appearance, and macroscopically a typical melanotic sarcoma. This was confirmed by microscopical examination. The patient was treated with the mixed toxins of erysipelas and bacillus prodigiosus for three weeks, without improvement. Death occurred three months later.

CASE IX.—*Neoplasms apparently primary in the cervical glands.* Dr. B., aged thirty-nine years, was referred to Dr. Coley by Dr. John A. Bodine, October 22, 1913, with the following history:

One sister died of cancer of the breast. In February, 1913, the patient first noticed a small painless tumor the size of a marble, in the region of the right submaxillary gland. This remained practically stationary in size, and was believed to be benign, until February, 1913, following a severe cold, when the tumor began to increase in size and grew rapidly. The surface became smooth and reddened, with much tenderness and pain. In a few days the swelling subsided, but became less movable than before. It was pronounced tubercular by a very experienced surgeon.

In the middle of October, he was seen by Dr. John A. Bodine, who regarded the tumor as sarcoma, and removed it. A specimen was examined by Dr. Jeffries (of the Hospital for Ruptured and Crippled), who pronounced it a round-celled sarcoma.

On October 22, 1913, the patient was referred to Dr. Coley for toxin treatment. Physical examination at that time showed a recent cicatrix in the right anterior cervical region. Just in front of the external auditory meatus was a small hard tumor, apparently rather deeply placed in the parotid gland, and rather fixed. This was apparently the seat of the disease. Under ether anæsthesia Dr. Coley removed this tumor, which was examined by Dr. James Ewing, and pronounced "a melanotic tumor, epithelial in type." The wound was then fulgurated with the Keating-Hart apparatus, and the patient then put upon the mixed toxins.

Two or three weeks later a recurrence took place, and a second operation was performed followed by a thorough fulguration and toxins. In spite of treatment, the disease recurred and slowly progressed. Examination October, 1914, showed well marked evidence of metastasis in the brain; condition hopeless. Death occurred in December, 1914.

CASE X.—Inasmuch as the following case has recently been reported in full, with microphotographs, in an article on "Primary Neoplasms of the Lymphatic Glands" (*Transactions of the American Surgical Association*, 1915) by Dr. Coley, only a brief history will be given here:

J. M. M., female, aged forty-three years. First noticed an enlargement of the submaxillary gland in July, 1911. Clinical diagnosis: Enlarged lymph-gland of submaxillary group. In January, 1912, under local anæsthesia the enlarged gland was dissected out and examined by Dr. E. S. Allen, who pronounced it a chronic adenitis, non-tuberculous. The disease recurred, and three other operations were performed, the last on September 30, 1914, at which time an incision was made through a former one on the left side of the neck and through the sternomastoid muscle. The tumor involved the internal jugular vein, so that a small portion of the latter was dissected in taking out the mass. Microscopical examination, by Dr. Graves of Louisville, Ky., showed it to be a melanotic sarcoma.

The disease promptly recurred, and on December 30, 1914, the patient was referred to Dr. Coley for the toxin treatment, which was given for two weeks; at the end of this time, the mass having considerably decreased in size, Dr. Coley removed as much of it as possible, although the operation was by no means complete. Microscopical diagnosis by Dr. Ewing: "Melanoma malignant." The toxins were immediately resumed and have been continued up to the present time. The patient has remained in good health and free from recurrence up to date—5 years since the beginning of the disease and 4 years since the first operation.

## MELANOTIC CANCER

CASE XI.—*Melanotic sarcoma of the neck.* R. A., male, aged twenty-two years, was referred to Dr. Coley by Dr. Oliver C. Smith of Hartford, Conn., on February 4, 1913.

The patient had always been in good health until the summer of 1912, when he developed enlarged cervical glands. These were removed by Dr. George Bell of Hartford, and on microscopical examination pronounced round-celled sarcoma. The disease rapidly recurred, and a second operation was performed by Dr. E. S. Judd of Rochester, Minn., in October, 1912. The pathological diagnosis was cellular carcinoma. Six weeks later a nodule appeared in the left infraclavicular region, which was dissected out by Dr. Oliver C. Smith of Hartford, and pronounced by Dr. Russ (Pathologist at the Charter Oak Hospital), melanosarcoma.

The multiple tumors were many of them of a bluish color and the whole clinical picture characteristic of melanotic sarcoma.

CASE XII.—*Melanotic sarcoma of the glands of the neck.* S. S., female, aged thirty-four years, was admitted to the General Memorial Hospital on May 9, 1914, with the following history:

Thirteen years ago had first noticed a small nodule beneath the angle of the jaw, which slowly increased in size.

Physical examination showed a mass the size of a hen's egg in the right anterior triangle of the jaw, and a nodule the size of a walnut to the right of the thyroid. Lymph-nodes in both axillæ were palpable. A large mass occupied the upper half of the abdomen, extending to the umbilicus below, and continuous with the liver. An exploratory operation was performed on May 14, 1914, and glands removed from the neck and groin. These were examined by Dr. Ewing, who pronounced them melanoma.

CASE XIII.—*Melanoma apparently primary in the axillary glands.* This case has also been reported in detail in a recent paper on "Primary Neoplasms of the Lymphatic Glands" (*loc. cit.*), and will be referred to only in abstract here. Microphotographs will be found in original report.

Male, twenty-four years old, was always in good health until November, 1914, when he had an attack of influenza; a week later noticed enlargement of the axillary glands. Shortly after, other glands appeared in the cervical region. Rapid generalization of the disease set in, causing death on January 10, 1915. The whole duration of the disease was only a little over two months. A microphotograph may be found with the report of this case (*loc. cit.*).

CASE XIV.—*Melanotic sarcoma primary in the matrix of the nail (melanotic whitlow).* W. J. W., male, aged thirty-seven years. Family history: Three paternal uncles died of cancer;

one of sarcoma of the scapula, and two of cancer of the tongue, at the ages of fifty-five, sixty-nine, and thirty-five years, respectively.

The patient was referred to me by Dr. Wm. T. Bull, in January, 1894. Eleven years before he bruised his left thumb, but did not lose the nail nor have any further trouble until December, 1892, when the thumb was again injured by being caught in a heavy window-cord. One month later consulted the local physician, who lanced it, evacuating considerable pus. It continued to discharge freely for several weeks, sometimes as much as one-half ounce of pus being evacuated.

First operation was performed by Dr. L. L. McArthur of Chicago, on February 1, 1893, who found necrosed bone beneath the nail, which, together with a part of the nail, was removed. There was no evidence of malignancy at that time. The wound, however, failed to heal, but continued to suppurate and became very painful. On April 15, the nail became very black, and curled up; discharge ceased. The pain increased in severity and on May 15 a portion of the tissues was removed, and on microscopical examination was pronounced melanotic sarcoma. The axillary glands soon became enlarged, and on June 6 a more extensive operation was performed, consisting in removal of the thumb and axillary glands. Three glands as large as an olive were found, and pronounced sarcomatous. On October 1, several small superficial and encapsulated tumors, the size of bird-shot, were noticed on the inner surface of the arm, three inches above the radius. Shortly after another tumor was noticed on the right side of the wrist, and still another on the mammillary line of the chest wall. From that time and on, numerous small nodules appeared subcutaneously in different parts of the body. On January 14, 1894, treatment with the erysipelas toxins was begun; the injections were made subcutaneously and chiefly into the buttocks, with little effect upon the tumors present, and others continued to appear in various parts of the body. Six months later the patient developed paralysis from metastases in the dorsal spine, and died in the latter part of April, 1895.

CASE XV.—*Melanotic sarcoma starting in the matrix of the nail; melanotic whitlow.* S. S., female, aged forty-two years. Family history good. Was referred to Dr. Coley in October, 1906, by Dr. Victor A. Robertson of Brooklyn, N. Y.

Six years previous an iron had fallen upon the patient's right big toe, causing loss of nail. When the new nail came in it was a very dark color. Three and one-half years later a similar accident occurred—a big iron fell upon the same toe. This time the nail came off only partly, and the new one was very dark in color. Considerable suppuration occurred about the nail, which was very

## MELANOTIC CANCER

slow in healing. In April, 1906, two years after the second injury, the patient had a third injury, caused by a door falling upon her toe, which bled freely at the time. The toe looked very unhealthy, and on July 1 Dr. Robertson removed the terminal phalanx. The wound failed to heal entirely, and in a few weeks the edges became dark blue in color. Shortly after this a mass of enlarged glands appeared in the femoral region of the same side. There was a good deal of pain and some œdema of the toe and leg.

Physical examination, October 6, 1906, showed the terminal phalanx of the big toe of the right foot absent; rest of the toe enlarged two or three times the normal size, the end being occupied by a large, unhealthy ulceration of bluish color; œdema of the whole leg, ankle and foot. The right femoral region was occupied by a tumor the size of a goose egg, evidently made up of enlarged glands. They were firm in consistence, more or less fused together, making a fairly movable tumor.

Later history not traced.

*Microscopical Examination.*—Made by Dr. Archibald Murray (Hoagland Laboratory, Brooklyn, N. Y.), October 1, 1906: Microscopical examination of the growth removed from toe, shows it to be an alveolar, large, round-celled sarcoma. Collections of large polyhedral cells are seen which are surrounded by strands of connective tissue of varying thickness. The blood supply is fairly normal. A few giant-cells are present and cells showing karyokinetic figures are rather numerous. The skin covering the growth is normal.

CASE XVI.—*Melanotic sarcoma of the heel.* E. J., female, aged fifty-nine years. Family history good. Was referred to Dr. Coley on March 26, 1909. Personal history: When a girl, had a nail in her shoe which greatly irritated the heel. Finally a small dark spot appeared in the inner side of the left heel, which remained unchanged in size or appearance until 1901, when it began to slowly increase in size; non-ulcerating, and purplish in color. The first operation was performed by Dr. A. D. King of Alleghany, Pa. The wound did not heal for several weeks. A recurrence took place shortly after, and in 1905 the mass was drawn out with plaster. Another lump almost immediately appeared along the edge of the old scar, and was removed. Two years later another tumor developed above the ankle, in the skin. This was removed by surgical operation, and a similar tumor developed above the knee of the same leg, and was also surgically removed.

Physical examination, March 26, 1909 (six years after the first operation) showed two typical melanotic tumors on the left foot, one over the instep, about two inches in diameter, involving the skin but non-ulcerative, and the other above the ankle. Over



the inner aspect of the thigh, were two or three small subcutaneous nodules, ranging from the size of a hazel-nut to a chestnut.

Later history not traced.

CASE XVII.—*Melanotic sarcoma of the heel.* R., male, aged fifty-seven years; farmer by occupation. On May 7, 1895, one of the writers (Coley) was called in consultation to see a case, and found the following condition: A very large fungating tumor the size of two fists, very dark, almost black in color, situated in the right groin, which had first been noticed by the patient two or three months previous. A diagnosis of melanotic sarcoma was made, although no primary tumor had been observed. Careful examination, however, revealed a thickened area  $1\frac{1}{2} \times 2$  inches on the ball of the foot, dark in color but non-ulcerating. The patient stated that it had started from irritation by a nail in his shoe, two years before, while plowing. It had gradually increased in size but had never ulcerated, and projected only slightly beyond the normal surface of the foot. This was believed to be the primary focus of the disease. The patient died a few weeks later. An autopsy was performed and this thickened area over the ball of the foot was removed, as well as some tissue from the groin. Diagnosis: Primary melanotic sarcoma.

This case illustrates the difficulties in making a positive diagnosis of melanotic sarcoma of the lymphatic glands.

CASE XVIII.—*Melanotic sarcoma or melanoma, apparently originating in the periosteum of the spinous process of the mid-dorsal vertebra.* Note: The clinical evidence in this case is so strongly at variance with the microscopic that we believe the diagnosis doubtful. K. E. A., female, aged fifteen years, was referred to Dr. Coley by Dr. James S. Chenoweth of Louisville, Kentucky, in August, 1915. The patient had always been well until the summer of 1913, when she struck her back against a wooden shutter. Nothing was noticed until the following April, when she felt a lump or a "bump" over the mid-dorsal spine. This remained about the same size until the Spring of 1915, when it began to grow rapidly. There was never any pain associated with it. The patient was operated upon by Dr. Chenoweth, on July 31, 1915, at which time he found a tumor involving the third spinous process of the seventh, eighth, and ninth dorsal vertebræ, extending downward some distance below. Dr. Chenoweth states that the tumor apparently originated in the tendinous structures and that the thin spinous process had been almost completely destroyed; no actual involvement of the bone was apparent. These spinous processes were removed, together with the tissues, well beyond the lateral margins of the growth.

As soon as the wound had healed, the patient was referred to Dr. Coley for treatment with the mixed toxins. She was given

## MELANOTIC CANCER

$\frac{1}{4}$  minim doses which later were increased up to the point of producing moderate reactions. In spite of the treatment, in early September, a well-marked evidence of a local recurrence was noticed, and the patient was admitted to the Memorial Hospital on September 7, 1915. The following day an operation was performed. Physical examination at this time showed three firmly fixed, more or less discrete tumors varying from the size of a hazel-nut to that of an English walnut, underlying the deep fascia, and attached to, if not springing from, the periosteum of the spinous process of the dorsal vertebra. A very thorough removal was made, together with the folds of the spinous process and neighboring fascia, and all of the tissue in the immediate vicinity. As soon as the patient recovered from the operation she was put upon the toxins in gradually increasing doses up to 12 minims. She was not very susceptible and had only one or two marked reactions. Up to October 11 she had had nineteen doses of the toxins and six X-ray treatments (Coolidge tube) given by Dr. Holding.

In spite of the treatment, in early October the disease began to reappear and grew very rapidly. On October 11 it was decided to perform a third and very extensive operation. With the assistance of Dr. William A. Downes an incision ten inches long was made and several tumor masses, more or less closely fused together, were removed. At this operation the tumor was found to be almost entirely on the right or opposite side from where it had been at the second operation. As in the other instances it apparently sprung from the periosteum or fascia, infiltrating the spinous process of the dorsal vertebra and involving the neighboring fascia. The base of the wound was cauterized with 20 per cent. chloride of zinc; wound closed; drainage.

The patient returned home on October 22, 1915. At this time there was already evidence of a local recurrence. The disease progressed very rapidly and in the latter part of November numbness and loss of power developed in both legs, and on December 5, there was complete paraplegia. Physical examination at this time showed a solid tumor occupying the entire right dorsal lumbar spine, extending almost across the entire back. The patient had very little pain, except in the latter stages of the disease. Death occurred on December 27, 1915.

*Microscopical Reports.*—First examination made at the Louisville Research Laboratory, by Dr. J. D. Allen, July 5, 1915. Examination of tumor removed from back: Macroscopically, tumor in its entirety about the size of an orange, firm, irregular and oblong in shape. Not encapsulated, infiltrating the surrounding muscular tissue, presenting a glistening appearance on cross-sections.

Microscopical sections show a mass of connective-tissue tumor cells, with very little stroma. The teased cells present long spindles, and in certain areas are grouped in giant-cells. Diagnosis: Spindle-celled sarcoma.

Examination of recurrent tumor made by Dr. James Ewing, September 9, 1915: Second of tissue reveals a tumor composed of small and medium round-cells, in diffuse or indistinct alveolar arrangement. In some places the alveolar arrangement is pronounced. Throughout the tumor many cells are distended with brownish yellow pigment. Hemorrhage is absent. The tumor is a highly anaplastic melanoma.

On account of the clinical history, Dr. Ewing stated that he was inclined to question the microscopical diagnosis, although the structure and pigment strongly indicate a true melanoma. The possibility of a primary tumor elsewhere than in the spine is not ruled out.

CASE XIX.—*Melanoma of shoulder starting in an irritated pigmented mole.* M. T., female, aged nineteen years. Family history negative. A small black mole had been observed over the upper portion of the left scapula ever since infancy. In the latter part of December, 1913, it had been greatly irritated by rubbing of the dress, which caused it to bleed. Shortly after, it began to increase in size, and was frozen off with liquid air. At this time, the patient states, it was about one inch in diameter. A local recurrence was noticed in September, 1914, and a second attempt at removal with liquid air was made. At this time a wider and deeper destruction of the tissue was made than at the first attempt. The patient remained well until June, 1915, when she noticed a lump in the neck, and little nodules appeared on both arms, back and chest. These continued to increase in size and number, until December, 1915, when she was referred to me; there were about seventy-five nodules scattered all over the body, most numerous about the face, neck and thorax. Both breasts were covered with nodules varying from  $\frac{1}{2}$  to  $3\frac{1}{2}$  cm. in diameter. Her general condition remained well during this period, and there was little if any loss of weight.

The patient had had X-ray treatment before her admission to the Memorial Hospital (in December, 1915), which was applied chiefly to the nodules over the chest. No apparent effect was observed. One nodule behind the right knee had been treated with an electric needle, with little change in condition.

Physical examination (at the time of her admission to the hospital) showed a well-developed, apparently healthy girl of nineteen years. No nodules on the head; pupils even and react to light; teeth in good condition; tongue and thorax normal; heart normal; lungs apparently normal; liver and spleen not palpable; glands not enlarged. Just to the left of the seventh cervical

## MELANOTIC CANCER

vertebra, in the mid-scapular region, was an old circular scar, one inch in diameter, at the site of treatment with liquid air. Scattered over the entire body were subcutaneous nodules varying in color from white to dark purple.

The mixed toxins of erysipelas and bacillus prodigiosus were given in small doses for two weeks, with little or no effect. On January 11, 1916, under ether anæsthesia, Dr. Coley removed from both breasts a number of nodules varying in size from a cherry to that of a hickory-nut. From these, an autogenous vaccine was prepared by Dr. Richard Weil, consisting of 10 per cent. suspension of expressed tissue juice, intravenously. Five injections of this vaccine were given, producing no chill, nor increase in temperature or pulse.

In the latter part of January, 1916, the patient had severe pain in the region of the right eye; vision was impaired, pain increased in severity and vomiting took place. On February 5, an X-ray picture taken showed enlarged glands in the right lung, which, according to Dr. Holding, were probably metastases. February 10, severe pain and vomiting continued, with irregular temperature and great loss of weight. Her symptoms pointed to brain involvement. Her general condition failed very rapidly. She returned home and died shortly afterward.

*Microscopical Examination* (by Dr. Ewing).—Small section of fibrous tissue is infiltrated by large typical alveolar, diffuse and perivascular melanoma free from pigment. The cells are large, clear and polyhedral.

In the following case several pigmented moles were present in various parts of the body, but there was no evidence of their having had any connection with the disease.

CASE XX.—*Melanotic sarcoma primary in the axillary glands.* J. W., male, aged thirty-eight years, was admitted to the General Memorial Hospital on May 6, 1914, with the following history:

Seven months prior to his admission he had noticed a small lump in the right axilla, about the size of a hazel-nut, which grew until it had reached the size of an egg in six months. First operation was performed at the Roosevelt Hospital, on April 20, 1914. On microscopical examination, the disease was pronounced perithelial sarcoma. Shortly after he began to have pain in various parts of the body, and several small lumps appeared in the skin, on the chest, back, arms, and thighs. Patient lost thirty pounds in weight.

Physical examination (May, 1914) showed numerous small tumors varying in size from a hazel-nut to an almond. In May,

1914, I removed a small tumor from the arm, which was examined by Dr. Ewing, and pronounced melanoma.

Toxin treatment was given for nine days, with no improvement, and then discontinued. The patient died on June 11, 1914. Fortunately it was possible to obtain an autopsy in this case, which showed many tumors in the liver, adrenals, spleen, vertebræ, and testes.

*Microscopical Examination* (by Dr. James Ewing).—Section of a malignant tumor infiltrating fat tissue. It has the general appearance of melanoma without pigmentation. The cells are large polyhedral, arranged in characteristic alveoli, surrounded by fine vascular stroma. No definite pigmentation.

The following case is fairly typical of the history of the beginning and end of a melanotic cancer. We have, first, the remote causative factor, *i.e.*, a pigmented mole; second, irritation of the mole by application of some form of caustic; subsequently (but unfortunately too late) the surgical excision, followed by generalization of the disease and death.

CASE XXI.—G. J. G., male, aged forty-three years, was referred to Dr. Coley on February 18, 1915, with the following history: Eighteen months before patient noticed a dark-colored mole, the size of a five-cent piece, and of uncertain duration, on the left shoulder-blade. The mole began to show a slight ulceration, and formed a pimple in the centre. This was cauterized with nitrate of silver for three months, during which time it had increased in size, and became harder in consistence. Six months later it had reached the size of a silver quarter, and was excised by his local physician. A specimen was not examined. A local recurrence took place and was again promptly operated upon in August 5, 1914. Microscopical diagnosis: small round-celled sarcoma (no mention of "pigment" was made). A third operation was performed in November, 1914, followed by a course of X-ray treatment; two treatments a week were given until he had received twelve. In spite of treatment, patient continued to fail and died in 3 months.

*Microscopical Examination* (by Dr. James Ewing).—Section is of an irregular mass of fibrous tissue infiltrated by a malignant tumor which has the general appearance of non-pigmented melanoma. The cells are large, clear, polyhedral and spindle, arranged in alveoli or about blood-vessels.

We have presented this clinical study of one of the rarer types of cancer in the hope that it might lead to earlier diagnoses and earlier



FIG. 1.—Melanoma starting in very large pigmented mole (multiple) on face. Generalization of disease.



FIG. 2.—Side view of same case as Fig. 1.



FIG. 3.—Melanoma of eye in child one and one-half years old (youngest of series).



FIG. 4.—Melanoma of neck, starting in pigmented mole.

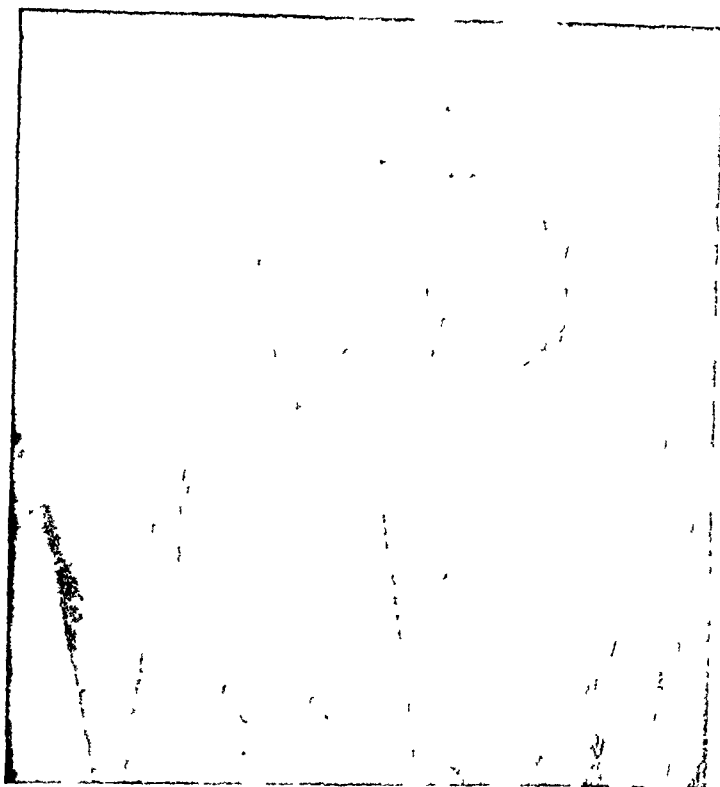


FIG 5 —Melanotic carcinoma, apparently starting in gland of neck (see Case 57 in table).



FIG 6.—Melanotic sarcoma of thigh. The wound as it appeared just before death of patient (in Case 32 in table).



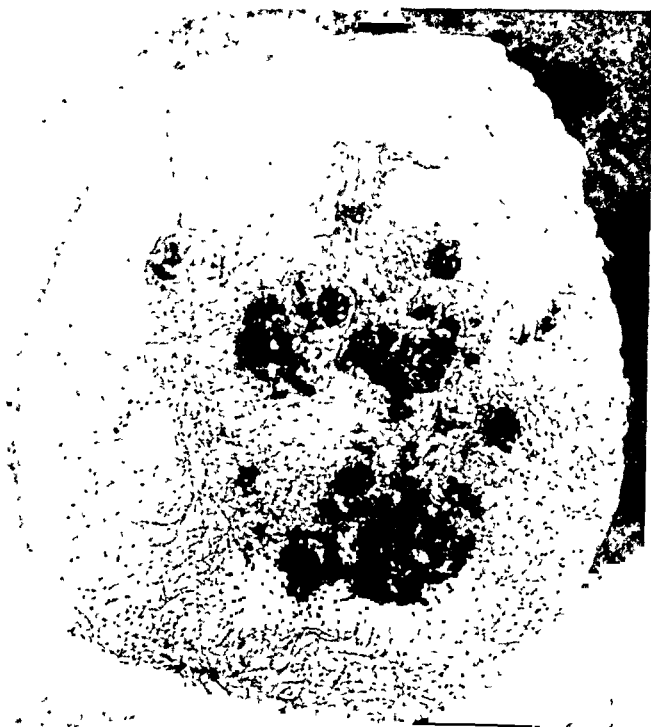


FIG. 7.—Melanotic sarcoma of thigh; primary tumor (see Case 31 in table).

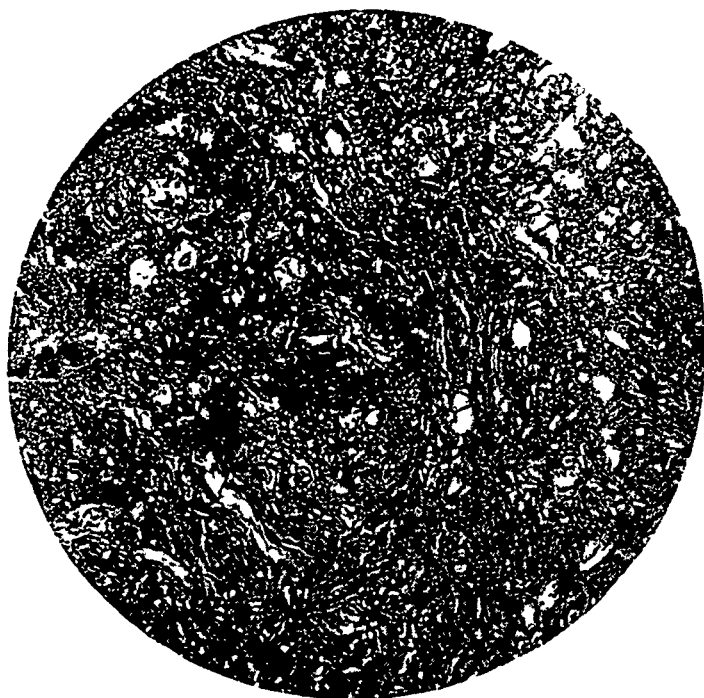


FIG. 8.—Primary in the neck.

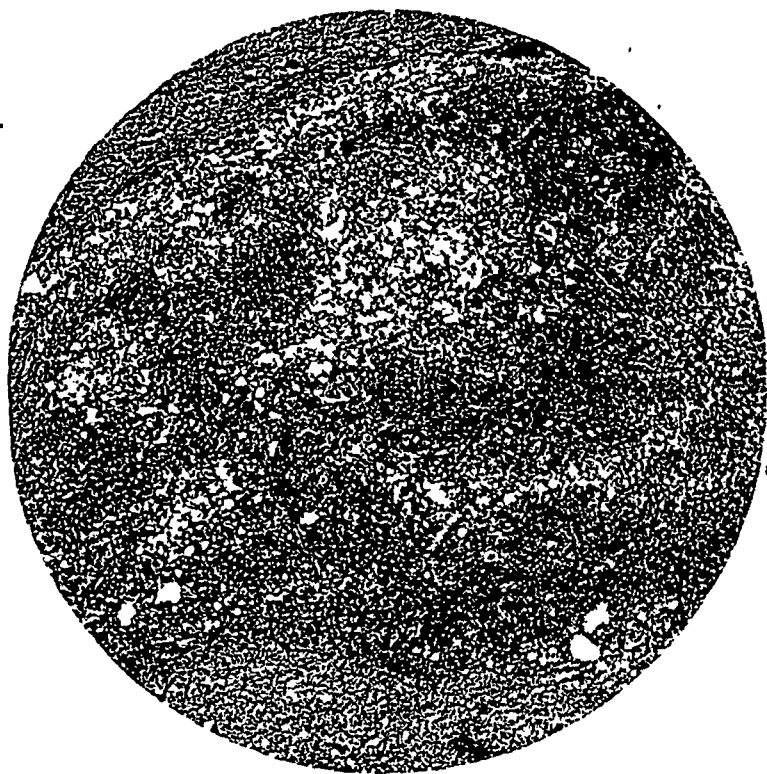


FIG. 9.—Primary in the scapula.



FIG. 10.—Primary in nasal cavity.

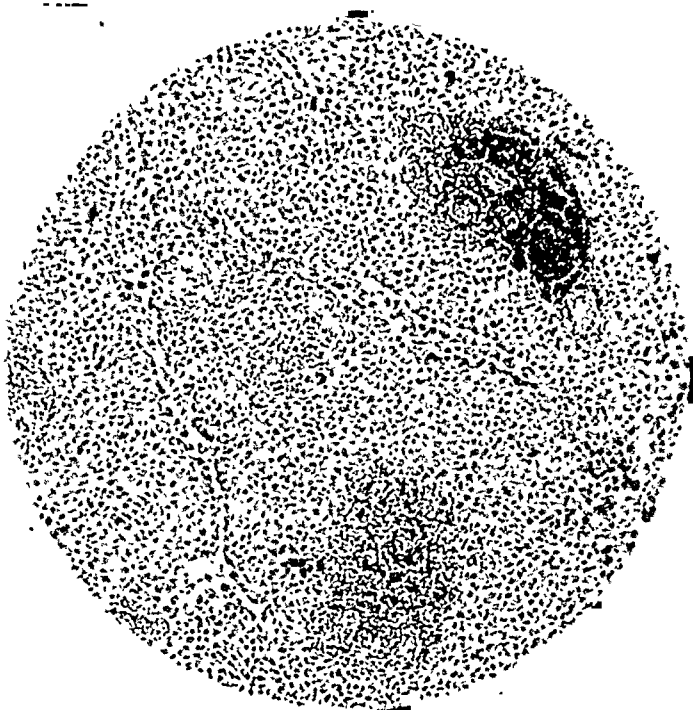


FIG. 11.—See Case 55 in table.

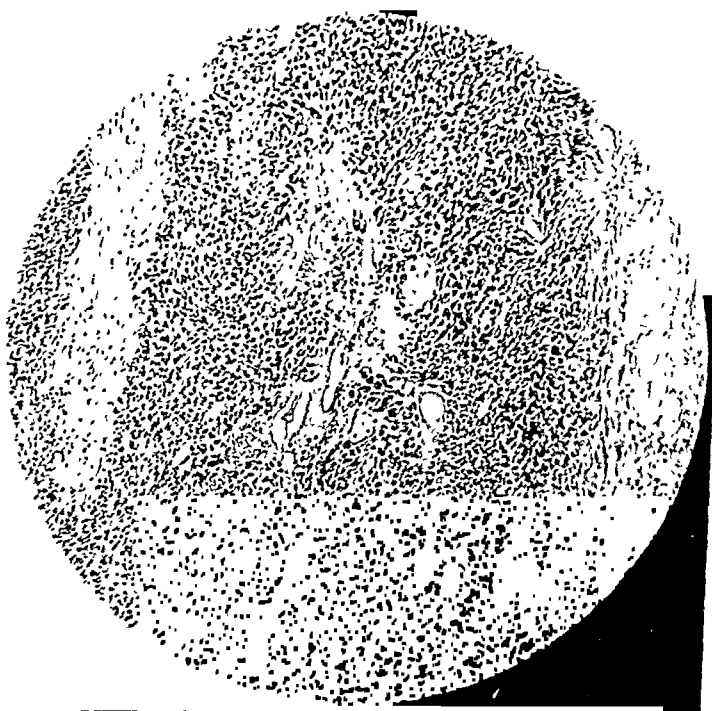


FIG. 12.—Melanotic sarcoma of scapula (see Case 16 in table).

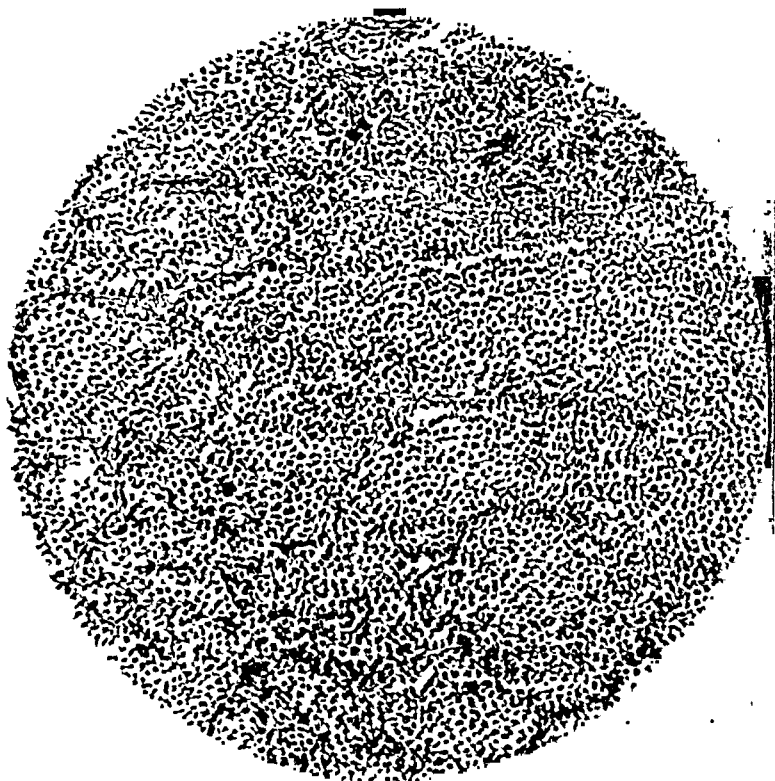


FIG. 13.—Melanotic sarcoma (see Case 2 in table).

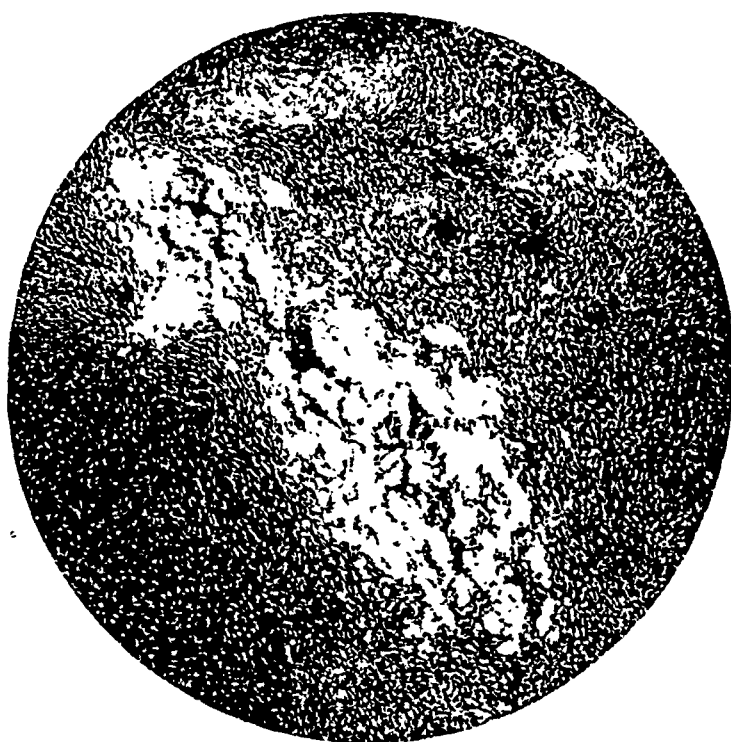


FIG. 14.—Case I.



FIG. 15.—Case I.

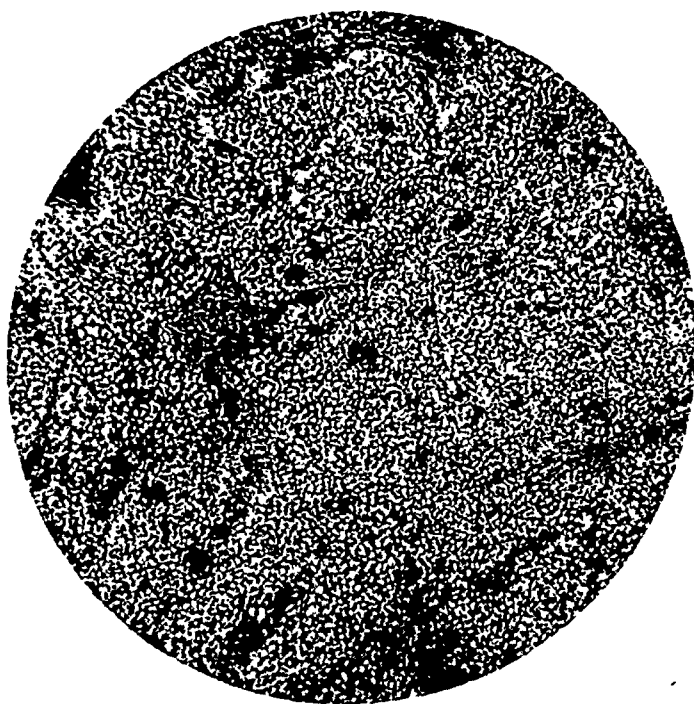


FIG. 16.—Case IV.

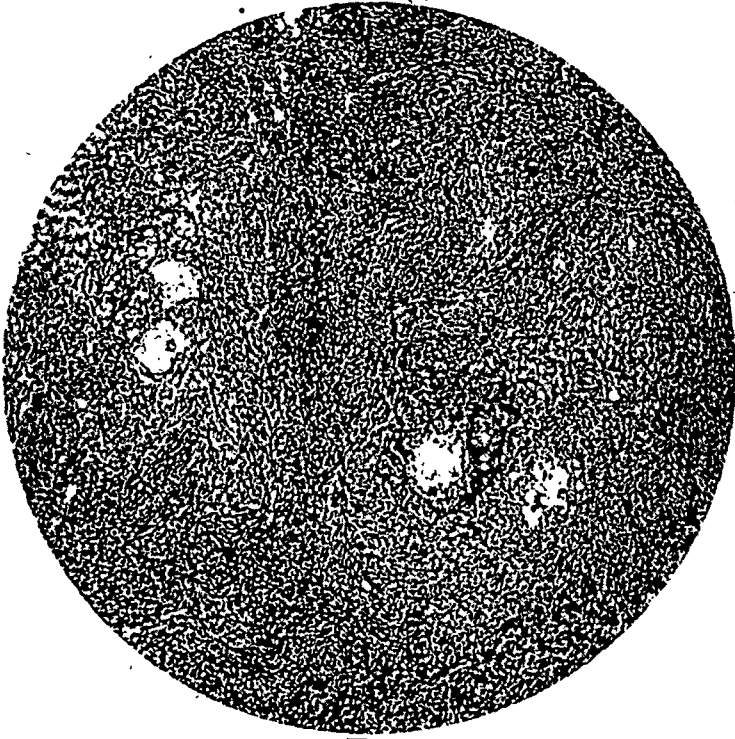


FIG. 17.—Case VII.



FIG. 18.—Case VII. Melanoma of calf of leg, starting in pigmented mole; irritated by clothing. Patient well six years after operation.

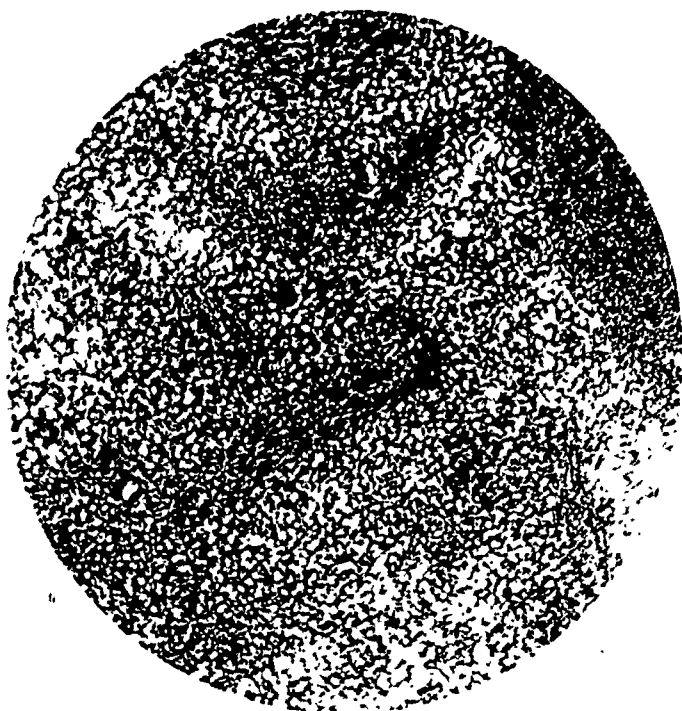


FIG. 19.—Case XI.

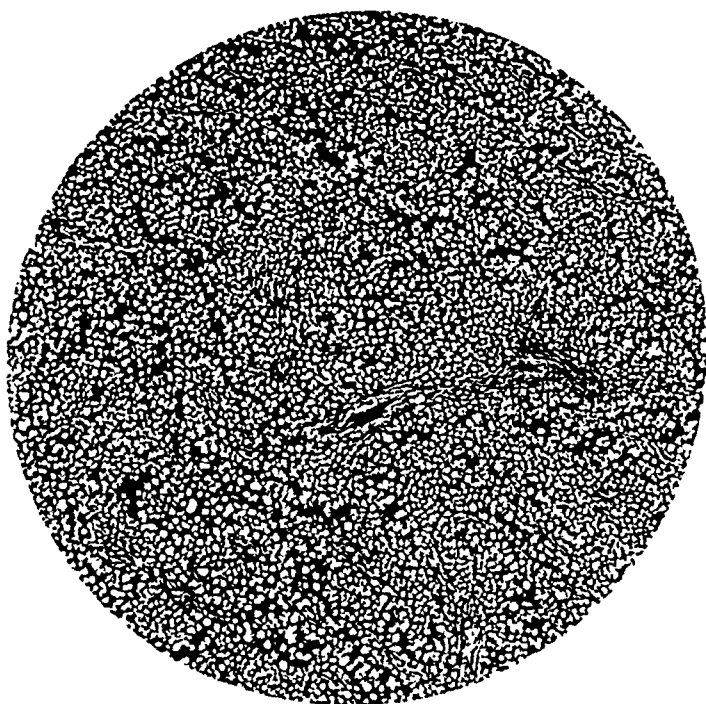


FIG. 20.—Case XVIII.

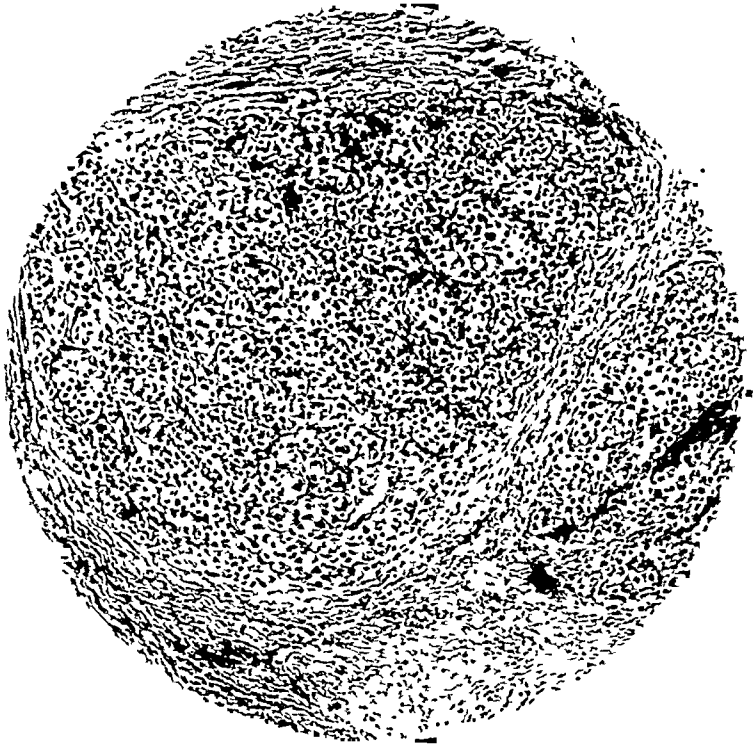


FIG. 21.—Case XIX.

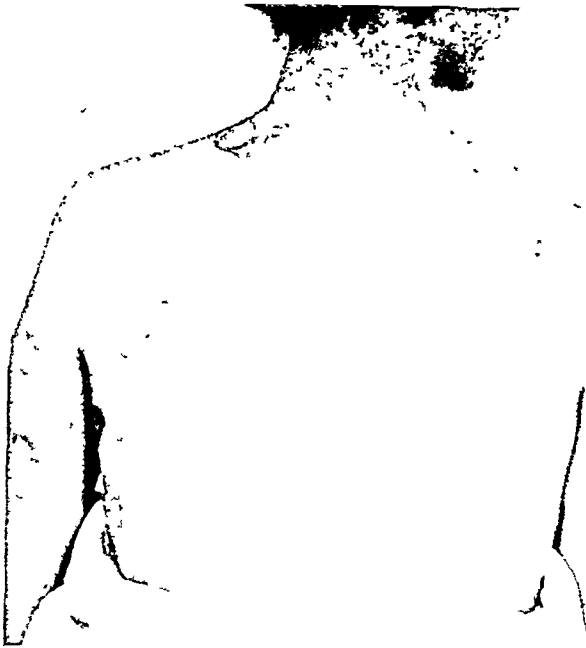


FIG. 22.—Case XIX. Melanoma primary in pigmented mole of neck, following removal with liquid air.



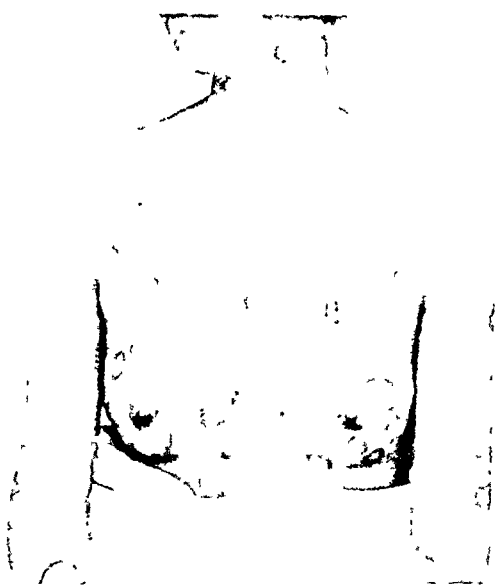


FIG. 23.—Case XIX, Front view of same case as Fig. 22.



FIG. 24.—Melanoma starting in ball of foot; metastases in inguinal, femoral and iliac glands.



FIG. 25.—Case XXI. Primary melanoma of shoulder.



## MELANOTIC CANCER

surgical treatment. The chief hope of reducing the mortality of this extremely fatal type of neoplasm must rest with prophylactic treatment, *i.e.*, the surgical removal of all pigmented moles, as soon as observed and particularly in all cases in which the anatomical locality renders them liable to irritation or to external injury. If this rule is rigidly followed we believe the number of cases will be markedly diminished.

Essential points in 91 cases as to sex, age, presence of mole, site of original tumor:

Males .....	51
Females .....	40

Age average in 82 cases (not stated in 8 cases) 36.8 years.

Mole present in 36 cases.

Site of primary lesion:

Not given .....	1	Back .....	4
Eye .....	11	Leg .....	5
Axilla* .....	4	Thigh .....	5
Back .....	5	Testis* .....	1
Neck .....	10	Foot .....	3
Shoulder .....	4	Abdominal wall .....	1
Behind ear .....	5	Toe .....	5
Cheek .....	2	Cervical glands* .....	2
Chest : .....	3	Scalp .....	1
Breast .....	1	Heel .....	4
Ankle .....	5	Face .....	2
Arm .....	2	Pubes .....	1
Rectum .....	1		
Groin .....	3		
			91

Cases of irritation of a mole = 17.

Removal of a mole in 14 cases, by surgery, electricity and caustics.

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\* In these cases no other primary focus could be found.

## PERSONAL CASES.

Name.	Sex & Age	Locality primary.	Etiology.	Histology, microscopic examination	Glands enlarged.	General metastases.	Treatment.	Result immediate.	Result final.	Total duration of life after first noticed.
1 J. W. . . .	M 38 1914	Right axilla	.....	Perithelial sarcoma; melanocarcinoma round-celled, varying to spindle-celled with pigments	No	Subcutaneous liver, adrenals, spleen, vertebral tissues	First operation, Roosevelt Hospital, Apr. 20, 1914; second operation, May 8, 1914. Toxins, May 8 to 17	No improvement	Died June 11, 1914	Oct., 1913-June 11, 1914.
2 N. K. . . .	M 21 1909	Between eyeball and eyelid	.....	Non-pigmented melanoma	Yes, throughout body	Subcutaneous lymph nodes, liver nodules in skin	Excision 1909, 1910, 1911; enucleation of eye, Apr., 1913. Tumor on abdominal wall removed June, 2, 1914. Vaccine treatment June and July, 1914; no result	.....	.....	1908 to 1915.
3 Dr. T. G. W. . .	M 37 1911	Lower part of back	Removal of mole by carbolic acid	Mixed-celled sarcoma with a preponderance of round cells	Yes	.....	Operations 1911, Dec. 1914; Toxins Dec., 1914, to date	Increase in duration in axilla	.....	1911.
4 Mrs. R. . . .	F 38 1894	Neck	Congenital mole	.....	Yes	.....	Operation Apr., 1894; three recurrences	No improvement	.....	Nov., 1893.
5 R. H. . . .	M 53 1900	Eye	Irritation	.....	.....	.....	Eye removed Apr. 15, 1900	.....	.....	12 years.
6 S. J. . . .	M 63 1895	Eyelid	.....	Typical melanoma sarcoma	Yes	.....	Recurrence July, 1900; 1st oper., Sept., 1894; 2d oper., Oct., 1894; 3d oper., Apr. 1895; 4th oper., July 1895. Toxins Aug., 1895, Oct., 1895, 4th oper.	Local recurrences and glandular involvement	Died	May, 1894 to Oct., 1895.
7 G. . . .	M 40 1906	Eye	.....	Melanoma sarcoma	No	.....	Eye removed, 1900	Mass in right side of abdomen	.....	1900 to 1906.
8 J. W. B. . . .	M 11 1913	Left eye	.....	.....	Yes	Multiple subcutaneous	Eye removed, 1907. Toxins 4 weeks, 1913	Recurrences, 1913	No improvement	1907 to 1913.
9 Mrs. C. . . .	F 70 1911	Eye	.....	Spindle and round-celled arranged in meshes with more or less intimate relation between cells and a basement substance penetrating between cells. Alveolar melanoma sarcoma	.....	Tongue and subcutaneous	First operation on eye, 1908	Recurrences 3 years after on tongue, then subcutaneously	No improvement	1908 to 1911.
10 Mr. E. B. B. . .	F 60 ..	Eye	.....	.....	.....	.....	Enucleation of eye, 1883	.....	.....	.....

# MELANOTIC CANCER

11	J. T. C. B.	M 40	Eye	.....	.....	.....	.....	.....	Operation on eye, Feb., 1911	No improvement	Rapid decline	7 months.
12	I. M.	M 23	1908 Axilla	.....	Melanoma round-celled spindle-	Yes	Lungs	.....	Operation, Sept., 1908, followed by toxins	.....	Death	
13	M. W.	F 50	1897 Below fold of axilla	.....	Melanotic alveolar sarcoma	Yes	.....	.....	Removal of growth on shoulder Dec. 1912; 2d oper. Feb., 1913, toxins until June	Recurrence in scar; removed O. K., Feb. 26, 1914	Death	
14	C. P.	F 60	1913 Right shoulder	.....	Large round-celled sarcoma	Yes	.....	.....	First oper. (?) 2d oper. Jan., 1913	Local recurrence after both operations		
15	J. A. F.	M 38	1913 Mole behind ear	.....	.....	Yes	.....	.....	1st oper. Feb. 1914; 2d oper. Oct., 1914	Recurrence at site of operations and extension	Steady decline	4 years.
16	G. G.	M 43	1914 Left scapula	Ulceration of mole	Small round-celled sarcoma	Yes	Metastases in spine	Metastases in spine	1st oper. Jan., 1902; 2d oper. Jan., 1904	Recurrence in scar		
17	R. F.	F 35	1906 Mole on cheek	Irritation of mole by needle and ligation	.....	Yes	Metastases in spine	Metastases in spine	Ligation of carotid	Steady increase in size of tumor	Steady decline in condition	5 years.
18	N. F. H.	M 45	1905 Mole just below ear	Irritation by caustics	.....	Yes	Subcutaneous metastases	Subcutaneous metastases	1st oper. June, 1910; 2d oper. Feb., 1911; toxins X-rays	Extension of growth	Metastases	18 months.
19	Dr. E. C. F.	M 38	1911 Mole in scalp behind ear	Removal	Melanotic sarcoma	.....	.....	.....	Operation July, 1895	Rapid recurrence; toxins	Increase in size of tumor; decline in condition	2½ years.
20	F. C.	M 25	1895 Right side of chest	.....	Typical sarcoma with pigment round, oval and spindle-shaped cells	Yes	.....	.....	Operation Dec., 1909			18 months.
21	Mrs. H. E. F.	F 26	1909 Lower chest	.....	Kaposi, pigmented hemorrhagic sarcoma	Yes	.....	.....	Both breasts removed July 1897	Rapid decline	.....	6 years.
22	M. F.	F 14	1898 Breast	.....	.....	No	.....	.....	1907, oper. on ankle; same year oper. on femoral glands. 3 more oper. X-rays	Rapid recurrence and increase in rapidity of growths	Decline	
23	Mrs. N.	F 37	1902 Ankle	Irritation of mole	Round- and spindle-celled sarcoma; much pigment in cells and connective tissue	Femoral and iliac	.....	.....	Operation on arm and axilla	Recurrence locally	Increase in size	Over 3 years.
24	W. H. C.	M 47	1900 Skin of arm	Injury	.....	Axillary	In abdomen	In abdomen	Oper. on rectum July, 1907			
25	Mrs. B. H.	F 49	1909 Rectum	Not given; has had hemorrhoids	Melanotic sarcoma	Abdominal	.....	.....				

PERSONAL CASES.—Continued.

No.	Name.	Age	Date	Locality primary	Etiology.	Histology, microscopic examination	Glands enlarged.	General metastases.	Treatment.	Result immediate.	Result final.	Total duration of life after first noticed.
26	Miss A. W. . .	F 33	1903	Ankle	Irritation of mole	.....	Femoral	.....	Oper. ankle Aug., 1902; recurrence; removed Oct., 1903	Increase in size of femoral tumor	Died May, 1904	13 months.
27	E. S. . . .	M 51	1906	Groin	Irritation of mole	.....	Femoral and inguinal	.....	Oper. July, 1905; local recurrence in Sept.	Loss of weight Oedema of leg		
28	H. . . .	M 20	1912	Back	.....	Round-celled sarcoma	Inguinal	.....	1st oper. 1910; 2d oper., 1911	Local recurrences and in groin	.....	1 month.
29	F. H. W. . .	M ..	..	Femoral region	.....	Mixed-celled sarcoma with pigmentation in places	Yes	.....	.....	.....	.....	
30	J. C. . . .	M 29	1900	Leg above ankle	.....	.....	Yes; in groin	.....	Oper. May, 1899; recurrence in July; oper. in Aug., 1900; recurrence in Sept.	Local recurrence after third oper.		
31	J. S. W. . .	M 55	1901	Thigh just above knee	Irritation from clothing	Typical melanotic sarcoma	Yes; inguinal	.....	Oper. July, 1901; local recurrence. Hip joint amputation Oct., 1901	Recurrence in abdominal wall and iliac glands; steady deterioration	Died Feb., 1902	
32	W. D. . . .	M 19	1897	Inner aspect of thigh	Ligature of mole	Melanosarcoma	Inguinal femoral iliac	Glands and surface of body	1st oper. Dec., 1895; 2d oper. Apr., 1897	Local recurrence in abdominal glands	Increasing weakness and emaciation	4 years and 4 months.
33	G. S. . . .	M 29	1897	Testis	Injury by fall from bicycle	Melanotic sarcoma	Inguinal	.....	1st oper. Jan., 1897; 2d oper. Apr., 1897; 3d oper. July, 1897. Toxins 3 weeks with no avail	Recurrence in inguinal region	Died Jan., 1898	1 year.
34	Mrs. J. E. C.	F 23	1906	Thigh above knee	Tied off mole with thread	Melanotic sarcoma	Inguinal femoral	Femoral, inguinal, and iliac glands	Extensive operation Nov., 1905	Rapid recurrence	Died, 1907	2 years months.
35	L. A. . . .	F 32	1909	Outer tibial region	Removal of mole by electricity	.....	Inguinal	.....	1st oper. 1904; 2d oper., 1906; 3d oper., 1908; 4th oper. Nov., 1908	Recurrence after each oper.	.....	5 years.
36	A. . . .	M 40	1909	Sole of foot	Treatment of wart by chiropodist	.....	Inguinal	.....	Oper. Feb., 1909, on sole and glands	Recurrence in glands	.....	9 months.
37	Miss X. . .	F ..	1910	Outer aspect of ilium	Ulceration of mole	.....	.....	.....	.....	.....	.....	4 years.
38	Miss H. . .	F 20	1897	Little toe	.....	Typical melanotic sarcoma; spindle-shaped cells	Inguinal	.....	Oper. Nov., 1897	Inoperable growth in groin and abdomen	.....	

# MELANOTIC CANCER

39	Miss A.	F 17/1912	Upper and outer aspect of thigh	Struck several times	Melanotic coma	sar-	No	Oper. Apr., 1912. Toxins for 2 years (100 doses)	No recurrence	.....	Well, March, 1915
40	R. A.	M 22/1913	Cervical glands	.....	Cellular carcinoma and melanoma sarcoma	Yes	Yes	.....	1st oper. July, 1912; 2d oper. Oct., 1912	Rapid recurrence after each oper.; steady deterioration	Died March 15, 1913
41	R.	M 32/1894	Scalp	Mole	Melanotic coma; rounded	Yes	Yes	Subcutaneous liver	None	Rapid deterioration	Died
42	E. I. S.	M 62/1901	Eye	.....	.....	.....	.....	.....	Removal of eye	.....	.....
43	S. S.	F 42/1906	Toe	Several injuries by iron objects falling on it	Alveolar round-celled sarcoma	Yes	Yes	.....	1st oper. Nov., 1903; 2d oper. July, 1905	Failure to heal	.....
44	H. F.	M 47/1908	Heel	Irritation by tight shoes	.....	Yes	Yes	.....	1st oper., 1905; 1908 amputation of leg	Rapid recurrences	.....
45	E. J.	F 59/1909	Heel	Irritation by shoe	.....	.....	.....	Subcutaneous	1st oper., 1903; 2d oper., 1905	Recurrences; loss of eyesight and strength	Dissemination
46	C. M.	M 21/1905	Forearm	.....	.....	Axillary	Axillary	Subcutaneous chiefly in upper extremity, chest and back	1st oper., 1905	.....	Dissemination
47	A. W. L.	M 35/1898	Cheek	.....	.....	Groin	Groin	.....	1st oper. Feb., 1895; 2d oper. Oct., 1897	No recurrence	Well when last heard from
48	G. R. C.	M 30/1904	Thigh near knee	Burn	Spindle-celled sarcoma	.....	.....	.....	1st oper. June, 1904; toxins 3 years	Recurrence in glands	.....
49	J. L.	M 33/1908	Ankle	Cauterization of mole	Melanotic coma; melanotic carcinoma	Femoral	Femoral	.....	1st oper. on ankle, April, 1907; 2d oper. femoral glands, Apr., 1908	Local recurrences and in femoral glands	.....
50	J. Q.	F 60/1899	Ankle	Excision of wart	.....	Femoral	Femoral	.....	Several attempts at removal of mole by caustics	Local recurrences and in femoral glands	.....
51	E. E.	M 31/1910	Calf of leg	.....	.....	Femoral and inguinal	Femoral and inguinal	.....	1st oper. Jan., 1909; 2d oper. May, 1909; toxins	Local recurrences in glands	.....
52	T. S. S.	M 43/1912	Outer side of foot	.....	Melanotic coma	sar-	.....	Upper thigh and in prostate	1st oper., 1910	Recurrence locally, and in thigh	.....
53	M. S.	M 20/1909	Ankle	.....	Melanotic thelioma	epi-	Inguinal femoral	.....	1st oper. Feb., 1909; toxins	Recurrence locally, at knee and glands	Well Aug., 1909; no recurrence
54	D. B.	M 39/1912	Neck	.....	Round-celled sarcoma; melanotic epithelial	Neck	Neck	Neck and prostates	Oct., 1912	Recurrence	Steady deterioration
											About 2 years.



## PERSONAL CASES.—Continued.

No.	Name.	Sex	Age	Locality primary.	Etiology.	Histology, microscopic examination	Glands enlarged.	General metastases.	Treatment.	Result immediate.	Result final.	Total duration of life after first noticed.
55	J. M. F. . .	M	1914	Back	Irritation by clothing	Melanotic carcinoma	Axillary nodes	.....	1st oper. Mar., 1914; 2d oper. June, 1914; 3d oper. Aug., 1914; on glands 1st oper. July, 1891; 2d oper. May, 1895; toxins	Local recurrences	.....	Over 4 years.
56	P. C. . .	M	1895	Neck	Mole off	Melanotic sarcoma; rounded cells; spindle cells; mucoid tissue and pigment	Yes	.....	Removal, 1885; removal in May, 1889	Recurrence; no effect	.....	
57	L. G. . .	M	1889	Neck	.....	Round and spindle cells; mucoid tissue and pigment	Yes	.....	.....	Recurrence not known	.....	
58	F. M. . .	M	1894	Neck	.....	Typical melanotic sarcoma; round-celled	Yes	.....	Oper. Jan., 1894; oper. June, 1894	Recurrences	Steady deterioration in general condition	10 months.
59	Mrs. B. . .	F	1895	Neck	Mole	Melanotic sarcoma; round-celled	Yes	.....	Oper. Apr., 1895; oper. Sept., 1895; toxins 5 weeks	General sarcomatosis	Died	Over a year.
60	Mrs. M. P. . .	F	1907	Neck	Mole	.....	Yes	.....	Oper. June, 1906	Recurrence	.....	1 year 3 months +.
61	J. S. D. . .	M	1912	Neck	Mole	.....	.....	.....	1st oper. Dec., 1912	Recurrence	.....	1 year +.
62	M. E. . .	F	1914	Axilla	.....	Hemangio-sarcoma melanoma	Yes	Over lower end of radius	1st oper. Apr., 1913; toxins and X-rays	3 recurrences	O.K. Feb., 1914	6 years.
63	C. H. T. . .	M	1903	Pectoral region	Mole; none found	Mixed-celled sarcoma with chromatin	Axillary	.....	1st oper. Feb., 1902. Axilla cleaned out Feb., 1913; toxins after	3 recurrences	.....	9 months +.
64	Dr. E. R. D. .	M	1912	Second toe	Ulceration of nevus, 1906	Pigmented sarcoma; oval and round epithelial-like cells	Groin	Right hemisphere of brain	Amputation of toe, 1908; glands removed, 1912; toxins 1 month	Recurrence in groin; recurrence tumor disappeared under toxins	Died, Oct., 1912	6 months +.
65	Mrs. J. A. F.	F	1915	Temporal region	Mole is irritated by combing hair	.....	Neck	None	Removal of mole; toxins	Recurrence in cervical glands	Still under treatment	2 years +.
66	W. B. . .	M	1912	Calf of leg	None known	Sarcoma epithelioma	Groin	None	1st oper. June, 1911; toxins May, 1912	Recurrence local and in glands; reduction in size of tumor	.....	Local recurrence
67	A. H. M. . .	F	1911	Heel	Trauma	Melanotic sarcoma	None	None	Oper. May, 1911	Local recurrence	Well, 1909	

# MELANOTIC CANCER

68	S. M.	F 43/1914	Neck	?	Perivascular and diffuse melanoma large clear cells and scanty pigmented area	Neck	None	None	Oper. Oct., 1911; oper. Jan., 1912; oper. 1913; oper. Sept., 1914; oper. Jan., 1915; toxins	Immediate local recurrence	Death Dec., 1915	5 months.
69	K. A.	F 15/1915	Back	?	Melanoma	None	None	None	Oper. July, 1915; oper. Sept., 1915; oper. Oct., 1915; toxins 19 doses; X-ray 6 times	Local recurrences	Died Nov., 1915	1 year 3 months.
70	M. F.	F 56/1914	Groin	?	Malignant epithelial tumor; cells arranged in small alveoli. Some areas show masses of polyhedral cells; no pigment melanoma suggested	Cervical; inguinal; axillary	Glands and subcutaneous nodules	None	Oper. Dec., 1914; oper. June, 1915	Local recurrences; later general	Died 1915	1 year 3 months.
71	M. P.	F 53/1914	Ear	?	.....	Cervical	None	None	Oper. 1905, on ear; oper. Jan., 1914	Recurrence 6 mos. after last oper.	Died, Apr., 1916	11 years.
72	E. B.	F 59/1913	Toe	Wart	Polyhedral cells in alveolar arrangement; red and yellow pigment present	Groin	None	None	Toe oper. in 1913; X-ray	Recurrence in groin 3 mos. after	.....	2 years.
73	M. O'C.	F 38/1915	Pubes	Mole?	Melanosarcoma	Inguinal	None	None	Oper. May, 1915	Local recurrence	Died	11 months.
74	C. McG.	F 50/1914	Behind ear	Irritation by collar	Mixed tumor of parotid	Cervical	None	None	Removal of mole by paste oper. Dec., 1914; X-ray	Local recurrences improved	.....	Over a year.
75	C. R.	F 48/1914	Toe	Irritation of mole by shoe	Granulation tissue with many large spindle cells, probably spindle-celled sarcoma	.....	.....	.....	Removal Oct., 1914	Recurred locally	Improved	3 years +.
76	V.	M 61/1915	Toe	Irritation of mole by shoe	.....	Inguinal; femoral; popliteal	Not known	Not known	Removal Apr., 1915 and Oct., 1915; X-ray; radium	Recurred around scars	Improved	1½ years +.
77	T.	F 18/1915	Back	Mole removed by liquid air	.....	Yes	.....	.....	Liquid air, X-ray with no effect; oper.; autogenous vaccine	Recurrence; loss of weight, pain	No improvement	2 years.
78	H.	M 47/1909	Calf of leg	Irritation of mole by clothing	Basal celled carcinoma; pigmented	Inguinal	.....	.....	Oper.; toxins	Improvement; disappearance of tumor	Patient well 7 years later	
79	H.	M 60/1915	Eye	Irritation of mole by shoe	Melanotic sarcoma	Mediastinal	.....	.....	Oper.; remained well for 3 yrs.; toxins no effect	Recurrence shortly after	Death in a few months	
80	K.	M 57/1895	Heel	Irritation of mole by shoe	Melanotic sarcoma	Groin	.....	.....	.....	.....	Death	2 years.
81	S.	M 50/1916	Foot	Irritation of mole by shoe	Melanotic sarcoma	Iliac and femoral	.....	.....	2 operations; toxins	Recurrence	Still under treatment.	

FOLLOWING 14 CASES TREATED BY OTHER MEN.

No.	Doctor's name.	Sex	Age	Locality primary	Etiology.	Histology, microscopic examination	Glands enlarged.	General metastases.	Treatment.	Result immediate.	Result final.	Total duration of life after first noticed.
1	Greenwood's case, Leeds, England	M	Adult	Neck	.....	Melanotic coma	.....	.....	Incomplete oper. Feb. 1911; 36 injections, toxins	Recurrence; reduction in size of tumor	Cured. O.K. May, 1916	
2	L. R. Dawson's case	...	...	Temporal region	.....	Melanotic coma	.....	Subcutaneous all over body	Removal, 1902	Recurrences	Deterioration	14 months.
3	Kammerer's case	...	...	Shoulder	.....	Melanotic coma	Axilla	Loin	1st oper. July, 1896; 2 others later	Recurrences	Rapid deterioration	1 year +.
4	T. S. McDermott's case	F	45	Retina	.....	Melanotic coma	.....	Lumbar region	Dec., 1904 enucleation of eye. Toxins Nov., 1905; Mar., 1907.	Recurrence in orbit	Died, June, 1910	6 years.
5	Van Duijn's case	F	...	.....	.....	Melanotic coma	.....	.....	Oper. 1897; 20 to 30 operations	Recurrences	Died Dec., 1899	2 years +.
6	S. S. . . .	F	34	Neck	.....	Melanosarcoma	Both axillae	Neck, axilla, abdomen, liver	No oper.; specimen removed	General condition progressing	Died, June, 1914	3 months.
7	M. S. . . .	F	61	Heel	Trauma	Melanoma	Groin iliac	Groin and abdomen	Oper., 1910, 1911, 1913	Local recurrences; glands involved after 1913	Died Apr., 1915	7 years.
8	M. F. . . .	M	50	Outer canthus of eye	.....	Melanotic coma	Glands behind and in front of ear	.....	1st removal May, 1914, electricity; recurrence and glandular involvement	Recurrence and glandular involvement	.....	4 years +.
9	V. C. . . .	F	37	Cheek	.....	Melanosarcoma	Neck	.....	Radium and oper.	Recurrence	.....	2 years +.
10	H. N. Lyon's case	F	23	Fibula below knee	Mole	Mixed-celled sarcoma with pigmentation	Groin and iliac	.....	1st removal Feb., 1913 Toxins Jan. 20, 1915	Prompt local recurrence with metastasis	No improvement	2 years +.
11	H. F. Hull's case	F	23	Leg	Traumatism to mole	Lymphosarcoma mixed-celled type	Groin epitrochlears axillary supra-clavicular	.....	Removal by cautery Feb., 1913; toxins	Local and general recurrences	No improvement	About 2 years.
12	S. R. Fowler's case	M	Adult	Jaw	.....	Melanotic	.....	.....	Toxins	Disappearance	Recurrence 2 years later Still well	
13	H. Lillienthal's case	F	20	Superior maxilla	.....	Spindle-celled osteosarcoma	.....	.....	Excision left superior maxilla incomplete removal of tumor; toxins	Entire disappearance		
14	F. E. Bunt's case	M	51	Toe	.....	Melanosarcoma	.....	Cerebral	3 operations; X-ray; toxins	Entire disappearance. Well for 2 yrs	Died Dec., 1915	3 years.

## MELANOTIC CANCER

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# OBSERVATIONS ON THE DIAGNOSIS AND TREATMENT OF TRIFACIAL NEURALGIA \*

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THESE conclusions are based on the results of treatment in 177 cases of trifacial neuralgia which have come under our observation.

*Diagnosis.*—Trifacial neuralgia is not often confused with any other disease by those who have seen a number of cases. It is a disease that has a distinct entity. In our series, males and females were about equally affected (male 96, female 81). A great many cases in which there was pain about the head and face due to sinus disease, disease of the nose and infection about the teeth or jaw are confused by the average practitioner with facial neuralgia and referred to the surgeons or neurologists as such. All cases of this nature have been excluded from this series.

The term *tic douloureux* is a misnomer, since there is no true spasm of the muscle associated with the pain. This muscular spasm occurs in only a small percentage of the cases, and is a voluntary or involuntary jerking of the muscles resulting from the sudden severe pain; the patient is startled by the lightning-like pain and the muscles of the face are contracted in consequence. Many patients attempt in every way possible to immobilize the muscles of the face for fear the attack may continue. Consequently, they refuse to speak in answer to questions, refrain from taking food or drink except when necessity demands it, and delay bathing the face as long as possible. The pain is always severe and comes in a short, sharp attack, like a shock of electricity. If the attack continues for a half minute or longer, it will be found on close questioning that the pain is not continuous, but is made up of a series of short, severe attacks interrupted by brief intervals. We have not seen cases in which the pain was of any other character.

A continuous aching pain or pain that throbs with the pulse certainly is not trifacial neuralgia. From our observations, and as Patrick has so graphically pointed out, the pain is very often started by the slightest irritation of a certain localized area on the face or tongue, and occasionally by the irritation of a single tooth. These areas have been

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## TRIFACIAL NEURALGIA

described by Patrick as "doloro genetic zones" or "trigger zones," which is a good description, since the slightest irritation of one of them is comparable to the lightest touch on the hair-trigger of a gun, and explosive pain follows the irritation immediately. The cause of the irritation may be very slight, a draft of air, a touch with cotton or the lightest touch of a finger. In individual cases the pain is invariably started by irritation of the same area.

The zones from which the pain most often originates are small areas on the upper lip, just at the alæ of the nose, and on the lower lip near the vermilion border at the angle of the mouth. These two points seem to predominate over all others. The pain produced by stimulating one of these trigger zones may not be confined to the same division of the nerve as the trigger zone itself. For instance, touching the upper lip at the angle of the nose may produce pain in the lower lip, lower jaw or tongue. *Vice versa*, stimulation of the lower lip or third division may produce pain in the second. Rarely does the stimulation of one division produce pain in another that is not adjacent. This has been such a common observation with us that when treating with injections we have adopted the plan of always injecting both the second and third divisions when but one of them is affected.

Our patients have not appeared to be more neurotic than the average. Most of them had never had any serious illness and were in good health so far as could be determined from their appearance and their examinations. Infection about the teeth and face is a very usual history, but since these are common to all persons it is questionable whether they have any real bearing on this disease. It is quite possible that later investigations will show that trifacial neuralgia is an infection of the nerve branches which progress to the gasserian ganglion. At least a great many patients who have had pain in a single peripheral nerve and who have been relieved by the removal of this peripheral branch have later returned with pain in another division or in all three divisions. This makes it appear that the disease might be progressive, extending from the periphery toward the ganglion. We have no proof to corroborate this theory except that it is known that certain bacteria have a selective affinity for nerve tissue as their habitat. Examination of 6 ganglia from trifacial neuralgia cases by Wilson showed marked inflammation in all. The average age was 50.6 years. We have not felt that arteriosclerosis plays any rôle in this disease. Heredity, rheumatic tendencies or extreme nervousness has not seemed to have any influence. The fact that people who suffer agonies for years almost never become addicted to the use of morphine or cocaine (one patient

in this series addicted to both) seems to indicate that at least their mental, if not their nervous stability, is above the average.

*Treatment.*—The treatment of trifacial neuralgia is essentially surgical. Medical treatment is confined to hygienic measures and seems to have but slight influence in the majority of cases.

*Excision or Evulsion of the Peripheral Nerve Branches.*—An excision or evulsion of the peripheral nerve branches was done in 19 cases. Three were supra-orbital, 9 infra-orbital, 5 inferior dental, and 1 lingual. Letters have been received from 10 of these patients. The longest period of relief in any of the series was two years. This was a patient in whom the infra-orbital nerve was evulsed and a screw placed in the foramen. Only 5 of the patients were relieved for one year or longer. The average time of relief was 8.4 months. Some of these patients had deep injections of alcohol subsequently and, therefore, have been included among those listed later, in the discussion of that method of treatment. None of the patients treated by excision or evulsion of the peripheral branches had any complications following treatment, and there has been no mortality in this group. The method of Kanavel for blocking the foramina seems to be the most rational that has been proposed, and although we have had no experience with it, we believe it should give better results than the older methods.

*Injecting Alcohol into the Main Nerve Branches at the Base of the Skull.*—Several years ago we adopted the method of Levy and Baudoin for injecting the deep branches of the nerve. We have treated in this way a total of 146 patients. Letters have been returned from 120. We have followed the method of inserting the needle the average distance for each branch and then moving it a little deeper, slowly, so that when the nerve was approached the patient would receive a shock of pain over the distribution of the branch. From this it is often possible to know that the nerve has been entered, or at least approximated very closely. This is especially true if there have been no previous injections. After the shock of pain has been noted, we have injected from 15 to 30 minims of 80 per cent. alcohol. We have not become skilful enough to locate the nerve each time an injection is made. In fact, this seems to be impossible. If the nerve is entered or approximated very closely the patient will be relieved at least temporarily. As mentioned previously, the plan has been followed of injecting both the second and third divisions when one of them was affected. Occasionally some bleeding resulted, which produced considerable tension underneath the temporal fascia. In three patients,

## TRIFACIAL NEURALGIA

there was inflammatory reaction of the cornea which cleared up within a few days; in two there was temporary paralysis of the external rectus muscle of the eye, and in six, stiffness of the muscles of mastication, which gradually subsided. The latter were patients who had had several injections. The length of time patients were relieved varied greatly, in one instance the relief lasting as long as five and one-half years, in another three years, and still another three and one-half years. This would seem to be very favorable. However, only 30 were relieved for one year or longer. The average length of time for the entire series of 120 from whom we have heard was 9.4 months, a slightly longer average than the time of relief following our series of operations on the peripheral branches. A discouraging feature of this method of treatment is that 77 of the 120 (64 per cent.) had relief of pain for six months or less. There has been no mortality in this series and no serious complications. More recently the injection of alcohol into the gasserian ganglion itself has been proposed. The technic of this operation has been perfected largely by Fritz Härtel of Bier's Clinic and by Urban Maes in this country. Maes reports that Härtel has injected 27 patients by this method and is satisfied with his results, reinjection rarely having been necessary. Maes himself treated his first case by this method in June, 1913, and reports lasting relief. He does not mention any other results. Up to the present time we have no evidence to show that the results following injection of the ganglion itself will be more permanent than injection of the deep branches. I can testify that isolation of sensory nerves elsewhere in the body and injection of a considerable amount of alcohol into their main trunks does not always give freedom from pain. We have no personal experience with injections into the gasserian ganglion. If this method of treatment becomes generally adopted, I feel certain that there will be many serious complications.

*Operation on the Gasserian Ganglion.*—Eighteen patients have had operations on the gasserian ganglion. Twelve of these were males and 6 females. The average age was forty-eight years; the youngest was thirty years of age and the oldest seventy. Thirteen of these patients had had some type of peripheral operation, and 2, previous operations on the gasserian ganglion, while all of them had had deep injections of osmic acid or alcohol into the various nerve branches for the relief of their suffering. In 9 of these patients, all three divisions were involved; in 6 there was involvement of the second and third divisions; in 2, involvement of the first and second, and in 1, involvement of the first and third. Eleven patients had the ganglion removed after the Hartley-Krause method, 1 was operated on by the



method of Abbe, and 6 by the method of Frazier. Thirteen of the 16 living patients have been completely relieved of their pain or the recurrences have been so slight that they consider their condition satisfactory.

The remaining 3 patients of this group have had recurrence. Two of these were operated on by the Hartley-Krause method and 1 by evulsion of the posterior nerve root. These recurrences must be considered, we believe, as due to the failure to remove either the entire ganglion or all of the fibres of the posterior root, a possibility in early cases when the operator's experience has not been extensive. My own experience would seem to show that enough emphasis has not been laid upon the one point of getting well behind the ganglion in order to expose all of the posterior root, especially to the inner side, before sectioning or evulsing it. I believe the failure in one instance was due to this fact.

There were two operative deaths in this series. One of them was that of a woman, sixty-one years of age, who previously had had an operation for the deep removal of the second and third divisions and later an attempt to remove the gasserian ganglion, both of these before she came under our observation. She died from late hemorrhage on the twenty-first day after operation. Undoubtedly the enormous amount of scar tissue from the two former operations was largely responsible for the fatal termination. The other patient, a woman forty years of age, never rallied from the operation, and died about twelve hours after leaving the operating room. Unfortunately a necropsy in this case could not be obtained. I am satisfied that hemorrhage was not the cause of death in this instance.

The results of operations on the gasserian ganglion, according to this series, are not entirely satisfactory, but probably this is due largely to the fact that some of the patients were operated on several years ago when experience in this work was not great. In our opinion the same number of patients operated on to-day would give approximately 100 per cent. permanent relief from pain.

The mortality in this series is much too high, and that of many a larger series of cases may be lower. However, the operation is serious and must not be undertaken too lightly. Surgeons who have not had considerable experience in surgery of the brain should not undertake the operation. The mortality as well as the permanent results may be improved only by those who have had such experience and are willing to do the most painstaking and careful work. In my own work the more gasserian ganglions I dissect on the cadaver the more I feel that it is a difficult and serious operation and that only when it is performed with

## TRIFACIAL NEURALGIA

the utmost care can one feel sure that all of the nerve fibres have been removed in an individual case. At the present time evulsing the posterior nerve root or removing the ganglion entirely is the only operation insuring permanent relief, and the mortality is no higher than that of many serious operations performed daily by surgeons throughout the country. Therefore, since patients with trifacial neuralgia do not recover spontaneously and the results of peripheral operations and injections are so temporary, this should be the operation of choice for a person in reasonably good physical condition.

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# DISLOCATION OF THE FIRST CERVICAL VERTEBRA \*

UNILATERAL AND BACKWARD: PRODUCED BY MANIPULATION

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THE complicated construction of the spinal vertebræ makes it impossible for the occurrence of a simple dislocation at any point below the cervical; though the term dislocation, without qualification, of the spinal segments in the dorsal or lumbar is often used. All lesions in these regions are dislocations with fracture of some part of the vertebra, therefore the term fracture-dislocation is applicable to all of them.

On the other hand, all vertebræ above the level of the seventh cervical, on account of the very much lessened obliquity of their articular surfaces, their great mobility and the absence of ribs, admit of dislocations without fracture. Before the introduction of the Röntgen rays, the diagnosis of simple cervical dislocation was more frequent than now. In our own experience, in the few recent cases that we have seen, we have been obliged to modify our clinical diagnosis of simple dislocation to fracture-dislocation when viewed with the Röntgen ray, so that it would seem that a cervical displacement without fracture is not common. The skiagram usually revealed a breaking off of a fragment of a transverse or spinous process or a part of an articular surface. In one instance there was a fracture of a cervical body. In the writer's opinion, one or more fractures take place more frequently than is revealed even by an X-ray negative, for the reason that the greater number of the skiagrams of the spinal column, in any region, are indistinct, in fact, in many instances, the picture is more or less of a blur, giving the röntgenologist an unlimited latitude for guesswork and speculation. It is possible usually to determine that the bones are displaced, but often there is not sufficient definition to determine the existence of fracture. Therefore, the usual classifications found in text-books need revision. As the Röntgen pictures have become more accurate, the appellation of fracture-dislocation in injuries to joints in every part of the body has become more frequent. The practical bearing of this advance in diagnostic accuracy is so evident that it need not be discussed in this connection.

The majority of cervical dislocations take place in a forward direc-

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\* Read before the American Surgical Association, May 11, 1916.

## DISLOCATION OF THE FIRST CERVICAL VERTEBRA

tion, and, if they do not cause instantaneous death, which occurs in most of them, they produce cord lesions consisting of more or less compression, varying in degree from slight sensory and motor disturbances to complete paralysis involving the four extremities. A dislocation with or without fracture, producing no cord symptoms, deserves to be recorded. The usual cause is by direct or indirect violence, such as a fall on the head, a blow in the neck or head, or a heavy object falling on the head or neck.

The case to be introduced, at this time, is of some interest, because it was a dislocation without fracture, as demonstrated by a skiagram and an open operation, and, further, it was produced by manipulative effort used with therapeutic intent.

A. C., farmer, appeared on August 30, 1915, at my regular afternoon consultation hour. He entered the consultation room with his head dropped forward, face partly turned toward the right side and his chin resting on his sternum. His eyebrows were highly elevated. His neck seemed to be fixed, for he did not make the slightest cervical rotation. As he sat down in a chair and presented a lateral view, the upper end of the cervical region projected sharply backward on the occiput. His appearance suggested a destructive cervical spondylitis or an occipitocervical neoplasm. He spoke with difficulty, for it was apparent that he could separate his jaws only to a very limited extent.

He stated that he had not been able to turn nor raise his head for more than a year, and that his condition was due to a treatment that he had received at the hands of an osteopath. He had gone to this practitioner to be treated for "generalized rheumatism." He had been placed on his back on an operating-table and the treatment was begun with vigorous and forcible rotations of the head. The operator, while standing at the head of the table, had grasped the patient's head with both hands, one resting on either side of it, two fingers, the index and middle, beneath each horizontal maxillary ramus, and, while being held thus, his head was "twisted" from side to side; extreme and forcible rotations were executed, causing great pain. He suddenly felt and heard a loud painful snap in the back of his neck at the base of the skull, and his head became fixed in the position described and had remained thus to the time of his visit. He stated that his condition had become unbearable on account of the pain in the back of his neck and occiput and his inability to separate his jaws enough to enable him to eat or speak with freedom. He had an almost constant vertical headache as well as pain in his neck since the accident.

*Examination.*—Any attempt to rotate his head caused a marked muscular spasm involving all the cervical muscles, especially the trapezei and sternocleidomastoids. An osseous projection was not only palpable but distinctly visible in the occipitocervical space. This appeared to be a spinous process belonging either to the first or second cervical vertebra. The tip of the spine appeared to deviate to the left of the median line. It was tender on pressure and caused him to flinch decidedly. An inspection and palpation of the pharynx disclosed an irregularity and tenderness at the nasopharyngeal junction.

It was evident that we had to deal with a luxated cervical vertebra, probably the first one, the atlas. There had been no cord pressure symptoms, except for an occasional tingling of short duration in both arms and hands. There had been no motor disturbances, all reflexes were normal and a careful search for sensory changes was negative. A skiagram presenting a lateral view of the cervical spine revealed a retrodisplacement of the atlas. The space between the posterior margin of the foramen magnum and the first cervical spine was clearly increased. The condition was not clear on first inspection, owing to the fact that the spine of the second cervical vertebra is much larger and longer under normal conditions than the first, in fact, the latter is usually absent and is rudimentary, and the further fact that a dislocation at this point, without a fracture of a transverse or articular process or the axis and an absence of cord lesion, is improbable. Therefore, we evidently had to deal with a slipping forward of the head on the atlas involving the occipito-atlantal articulation. The occipital condyle, probably the left one, had slipped forward so that it rested in front of the margin of the left superior articular surface of the atlas, causing a fixed rotary anterolateral flexion of the head. The patient was informed of his condition and advised to return to the osteopath; because this class of practitioners consider themselves super-bone-setters. He declined in as vigorous English as his set jaws would permit and insisted that the writer make a manual reduction. He was informed that this was out of the question, because one could not hope to reduce a dislocation in this region that had existed more than a year, much less hope for an accidental re-adjustment, and at the same time avoid an injury to the medulla. It was agreed that an effort at manual reduction should be made and, if unsuccessful, an immediate open operation should be done.

Accordingly, under complete ether anæsthesia, guarded rotary manipulations with pressure over the prominent cervical spine were carried out and, as was expected, without results. The patient was placed in the ventral position, and brought forward on

## DISLOCATION OF THE FIRST CERVICAL VERTEBRA

the operating-table so that his shoulders rested on its edge and the forehead was placed on a Cushing bench. A laminectomy had been planned, for it was considered impossible to affect a safe operative replacement of the dislocated atlas after it having been displaced for more than a year. The chief object to be achieved was to remove the left axial facet as well as the lamina to enable the patient to elevate his head, so as to relieve the pressure of the chin on the chest. Through the usual posterior incision the arch of atlas, together with the left superior articular surface, was removed with a Röntgen forceps. A distinct anteroposterior movement of the head could not yet be made. While the right atlo-occipital articulation was affected only in a rotary way, and its articular surfaces were in contact and were immovable, it was decided to remove enough of the articulation to mobilize it. This was accomplished so that anteroposterior movements became fairly good. The wound was closed and dressed in the usual aseptic manner. The operative recovery was normal. The immediate operative effect was to permit the raising of the head, so that the chin was free from the chest, enabling him to masticate and speak freely. With effort the head could be elevated to a normal position, but he was not able to maintain it for more than a few minutes. There was moderate rotation. Pain and muscular rigidity had disappeared.

Dislocation of a cervical vertebra, without fracture and without cord lesions, is rare except at the atlo-occipital articulation and between the first and second vertebræ—the atlanto-axial region. In the latter case the chances are in favor of a fracture of the odontoid process. The transverse ligament usually offers sufficient resistance to bring this about. It is true, the transverse ligament may be torn from its tubercles and allow a backward dislocation of the axis. In that event cord compression would be inevitable and a fatal termination almost certain.

In our case we had to do with a unilateral dislocation without cord symptoms. Had we had a bilateral dislocation forward, a fatal cord compression could scarcely have been prevented.

The interesting feature of our case is the manner of the production of the luxation. We naturally ask ourselves, did the misplacement occur by the force of the one particular movement in which the articular surfaces parted, or was it a succession of movements that started it, little by little, stretching the ligamentous attachments and possibly tearing a few fibres with each rotation, as might be suggested by the pain and cracking experienced with each "twist" of the head, until

the last ones yielded, permitting the displacement to be complete? The operator informed the patient that all his pains were due to several misplaced vertebræ, that they were pressing on certain spinal nerves causing his "generalized muscular and articular rheumatism" and that it was necessary that the "luxated spinal bones" be replaced and, since his trouble had existed a long time, it might be difficult to effect a reduction and therefore extreme efforts might be required. Accordingly, the osteopath began to rotate the subject's head from side to side, at first without producing discomfort, then the rotations became more vigorous and with increasing pain until each movement produced a "cracking" sensation in the neck, until a supreme effort was made to reduce the imagined luxation, ending in an extremely painful "snap" leaving the head in a fixed position, establishing a real dislocation which our advanced hyper-manipulator did not recognize, for an imaginary luxation which was non-existent. A strange system of therapeutics that trains a man to see things that have no existence and blinds him to those which are tragically real. The method of manipulation and the pain experienced with the increasing force employed would suggest the belief that the misplacement did not occur with the one final decisive movement, but that the many rotations gradually prepared the peri-articular structures and the joint surfaces so that the atlas began to rotate on its vertical axis and finally slid with the last rotary effort from its articular bed to its malposition where it became fixed.

Naturally the possibility of a replacement of a dislocated atlas suggests itself. It might be accomplished in a recent case by manipulative effort. The chances for failure, however, are great and an open operation may be inevitable. External efforts may be ineffective on account of the great mass of muscular structures laterally and posteriorly. Pressure in the pharynx with anteroposterior or rotary movements, together with traction on the head, may accomplish very little when we take into account the obliquity of the articular surfaces of the atlas, especially the sharp upper articular margins. When once the occipital joint surface, which is concave-ovoid, has slipped over the sharp axial margin, nothing short of leverage would appear to be effective. The atlas, itself, is not massive, it has no body or spinous process—it is an irregular slender ring of light construction. It is located in a region rather difficult of access. It encircles a most vital structure, the medulla oblongata. It would seem that a reduction by manipulation would be as much of an accident as the force that produced

## DISLOCATION OF THE FIRST CERVICAL VERTEBRA

the dislocation. Operative measures in recent cases involve great technical difficulties as well as unusual danger.

In old luxations in this region, the danger and difficulties are increased so that reduction by operation is highly improbable on account of the cicatricial tissue which firmly holds the atlas in its position. Therefore in those cases where there is an absence of pain and discomfort and the deformity does not greatly interfere with general activity, non-interference will be the best plan. In cases, however, where there is great distress and malposition, the removal of such parts of the bone as will relieve the discomfort and correct in part the deformity is indicated.



# A METHOD OF TREATING CYSTS OF THE BREAST\*

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CONSULTING SURGEON TO THE MONTREAL GENERAL AND ROYAL VICTORIA HOSPITALS

A NUMBER of years ago I was asked to assist a surgeon in an operation for the removal of the breast from the wife of a colleague. The case was supposed to be malignant, without any involvement of the axillary glands; the tumor was hard, nodulated, had been noticed for some weeks and appeared to be increasing in size; it was situated in the lower zone of the right breast. The breast was removed and on examination the tumor proved to be a simple cyst containing clear fluid; it was so full of fluid that there was no sensation of fluctuation. This case impressed me much and I then suggested to my colleagues that if the cyst had been tapped it would have collapsed and there would have been no necessity of removing the breast.

After this in any doubtful case I always put a needle into the growth; if it was cystic the fluid was evacuated and the tumor instantly disappeared, and if it was a solid growth it was easy to tell. In some cases of scirrhus the resistance and peculiar sensation conveyed enabled me to make a diagnosis. As long as the fluid evacuated from the cyst was clear I had no doubt of its non-malignancy, but if it was bloody fluid, then the case was operated upon. The following cases taken at random from my notebook will do for illustration:

CASE I.—Miss D., aged forty-eight, came to me in May, 1900, complaining of a swelling in the left breast; it was painless but she felt some discomfort from it. She had only noticed it for a couple of weeks. On examination I felt a smooth, round, hard tumor in the left lower quadrant; the glands in the axilla could not be felt. I did not think it malignant, but as a matter of procedure put in a needle and immediately evacuated nearly two ounces of clear fluid. I did not see her for some time, then she told me the fluid had partially re-collected, but gave her no discomfort. I saw her a few days ago (February, 1916), she was quite well and no tumor could be detected in the breast.

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\* Read before the American Surgical Association, May, 1916.

## CYSTS OF THE BREAST

CASE II.—Mrs. F., aged forty-five, in June, 1903, came to see me to get an opinion on her case, as a surgeon whom she had consulted told her she had cancer of the breast and it must be removed. She had a hard lump on the inner side of the left breast which she had noticed for some months; she thought it was growing. Never had an injury to the breast, or sore breast, when nursing. The lump on the inner side of the breast was of apparently stony hardness. As is my custom, I put in a needle and immediately evacuated two drachms of clear fluid. She had a little soreness and some inflammation after the puncture, but this soon subsided and the cyst never reappeared. The next year she came back to me with a similar tumor of the right breast, which was quite evidently a cyst. Some time later this was tapped and nearly an ounce of clear fluid evacuated. A rather hard base could be felt after the tapping. This patient lived until 1915 and died of some disease unconnected with the breast.

CASE III.—Miss K., nurse, aged forty, in July, 1907, came for my opinion, as the surgeon for whom she worked told her she had malignant disease and wanted to remove the breast. She had noticed the growth some time, but did not think it had grown lately. Had some time before been struck in the breast by a delirious patient. On examination, found a hard tumor apparently the size of a pigeon's egg on the inner side of the left breast. No enlargement of axillary glands. I put a needle in and evacuated about half an ounce of clear fluid. There was no further trouble and she is still well, 1916.

CASE IV.—Mrs. B., aged forty-four; married; three children, the youngest, fifteen. She was sent to me February, 1910, by Dr. H., for the purpose of having the breast removed for supposed malignant tumor. The patient never had any trouble while nursing, but a few months ago received a severe blow on the right breast. She noticed the tumor three weeks before coming to me. The examination showed a lump the size of a pigeon's egg, very hard, non-fluctuating, on the right lower quadrant of the breast. There was a small hard nodule above the nipple. A needle was put in and two or three drachms of a rather thick, milky fluid withdrawn. The tumor immediately disappeared. On March 25, 1915, she returned with the tumor above the nipple, seen on the first occasion, as a very small nodule, much enlarged. This was tapped and clear yellow serum escaped. I had not seen her after the first tapping, five years before, and had told her to come back should the nodule above the nipple enlarge. There was no trace of the first cyst tapped.

FRANCIS J. SHEPHERD

These are a few examples of the cases treated, and by this simple procedure a positive diagnosis was made and the anxieties of the patient greatly relieved and without the necessity of an operation, even a minor one. In multiple small cysts this method is of no value and the breast ought to be removed. I have seen and tapped many cases and as they never returned to me I presume they went on favorably. Many of these cases I have been unable to trace.

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## TUMORS OF THE CAROTID BODY\*

BY RANDOLPH WINSLOW, M.D.

OF BALTIMORE, MARYLAND

THE occurrence of tumors of the carotid ganglion is of sufficient infrequency not only to justify but to make desirable the recording of all such cases. I therefore desire to place on record two cases that have come under the observation of my colleague, Dr. Arthur M. Shipley, and myself, respectively.

CASE I.—A young woman, aged sixteen years, had on the right side of her neck a hard lump the size of a hen's egg, deeply seated, and about opposite the hyoid bone. It presented just in front of the anterior margin of the sternocleidomastoid muscle. It was slightly movable from side to side, but not movable in the vertical direction. Its position was so deep that it seemed to be in very close relationship to the transverse processes of the cervical vertebræ. The patient had suffered no inconvenience from the mass, there were no symptoms, and the reason she came for operation was the presence of a growing lump in her neck that she had only noticed for about two months. Examination showed no evidence of pressure upon either the pneumogastric, hypoglossal, or recurrent laryngeal nerves. The lump was single and the most careful palpation failed to reveal the presence of other masses in the neck. Because it was so firm, so fixed, single, and so deeply seated it was thought to be a sarcoma, and a diagnosis of carotid tumor was not made before operation, which was done November 30, 1910.

Under ether anæsthesia an incision was made by Dr. Shipley along the anterior margin of the sternomastoid muscle, and the lump isolated. It was found to be firm in consistency, not attached to the vertebræ, and after careful dissection it was seen that the common carotid artery tunneled the growth. The internal jugular vein was firmly incorporated in the mass, but the pneumogastric

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\* Read before the American Surgical Association, May 11, 1916.

nerve was not seen. The growth could not be removed without the removal of the entire carotid sheath; so the common carotid artery and internal jugular vein were ligated above and below the growth and the mass lifted out. Almost immediately after the proximal ligature was applied the anæsthetist noticed a marked change in the character of the pulse. Up to this time the patient had been taking a quiet anæsthetic, with a good pulse. The pulse immediately became very fast, but was still regular. The operation was hastily concluded. The wound was sutured without drainage, and the patient returned to bed with a pulse around 160. The pulse did not improve, continued rapid, and, indeed, at times, was above 180. It was regular, however, and of fair volume. This rapid pulse continued four days, but during this time the appearance of the patient was good. In spite of the rapid pulse she had very little discomfort, no dyspnoea, and no cyanosis. The only treatment during this time was an ice-bag over the heart and hypodermic doses of morphine. After four days of this rapid pulse the patient was given strychnine nitrate, gr.  $\frac{1}{30}$ , hypodermically. Within a few hours from the beginning of the administration of the strychnine the pulse rapidly improved, and on the morning of the fifth day was 100. This patient made an otherwise uninterrupted recovery, and recently, after a lapse of four years, returned to the hospital with a chronically inflamed appendix, which was removed. At this time there was no evidence of recurrence. (The notes of this case were kindly furnished by Dr. Shipley.)

CASE II.—L. L. S., white, male, aged twenty-four years, was admitted to University Hospital, Baltimore, on April 20, 1914, and was discharged on May 8, 1914. He complains of a "swollen gland on the left side of the neck." His family history is absolutely good and his personal history not important. His habits are good and he does not use alcohol or tobacco.

About eight years ago he noticed a small lump on the left side of the neck, which has gradually enlarged until it is now the size of a small hen's egg. This tumor is single, smooth, hard, somewhat movable, but also fixed. It is not painful, but on deep pressure tenderness is elicited. The surrounding tissues are not thickened. The tumor is situated in the upper carotid triangle on the left side. There is no aphonia, but occasionally some hoarseness. No pulsation or bruit was noted, and the circulatory system was not abnormal. He had a discharging ear five years ago and has lost some flesh in the last six months. The lungs, heart, and other viscera seem to be in a normal condition.

On admission his temperature, pulse, and respiration were practically normal, as was also the urine.

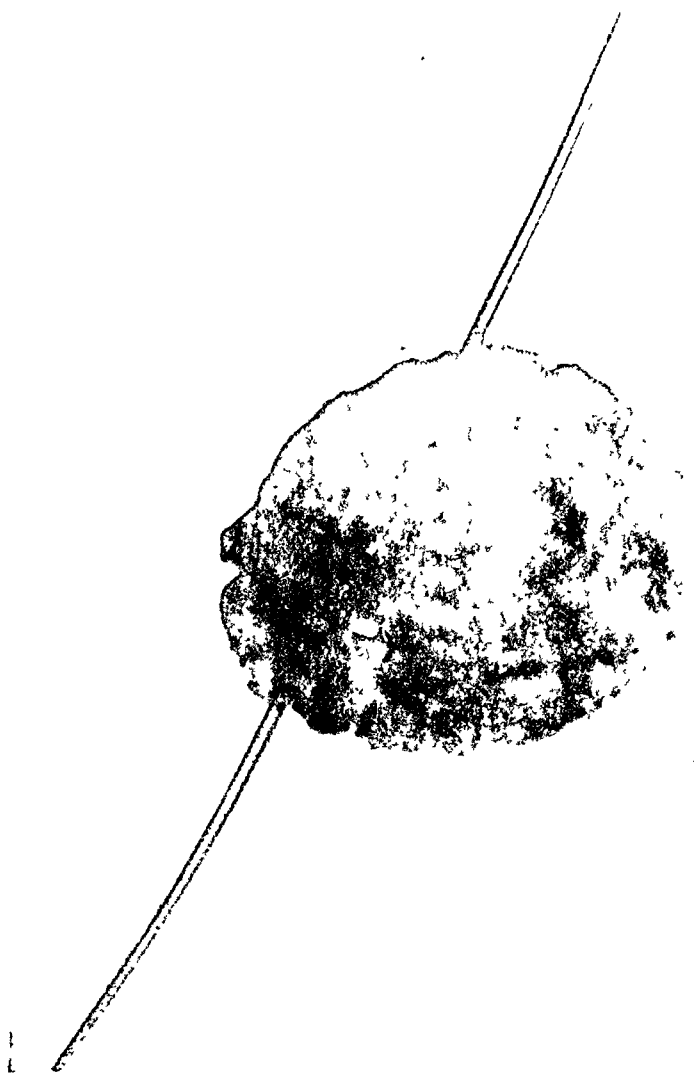


FIG. 1.—Gross appearance of carotid tumor.

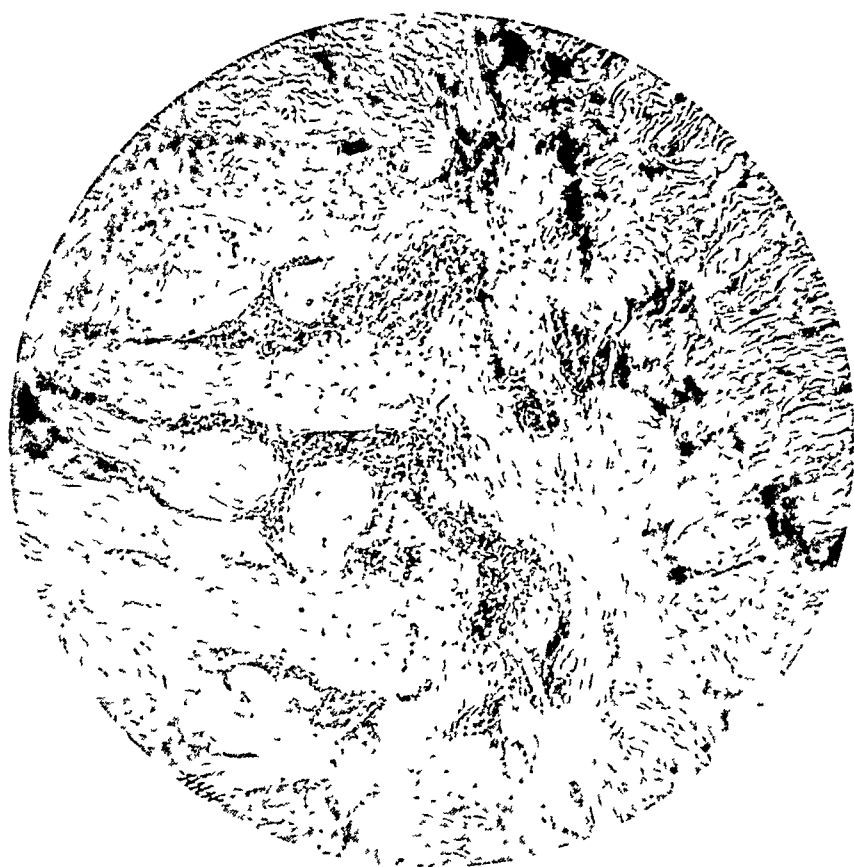


FIG 2 —Section of carotid tumor ( $\times 65$ )

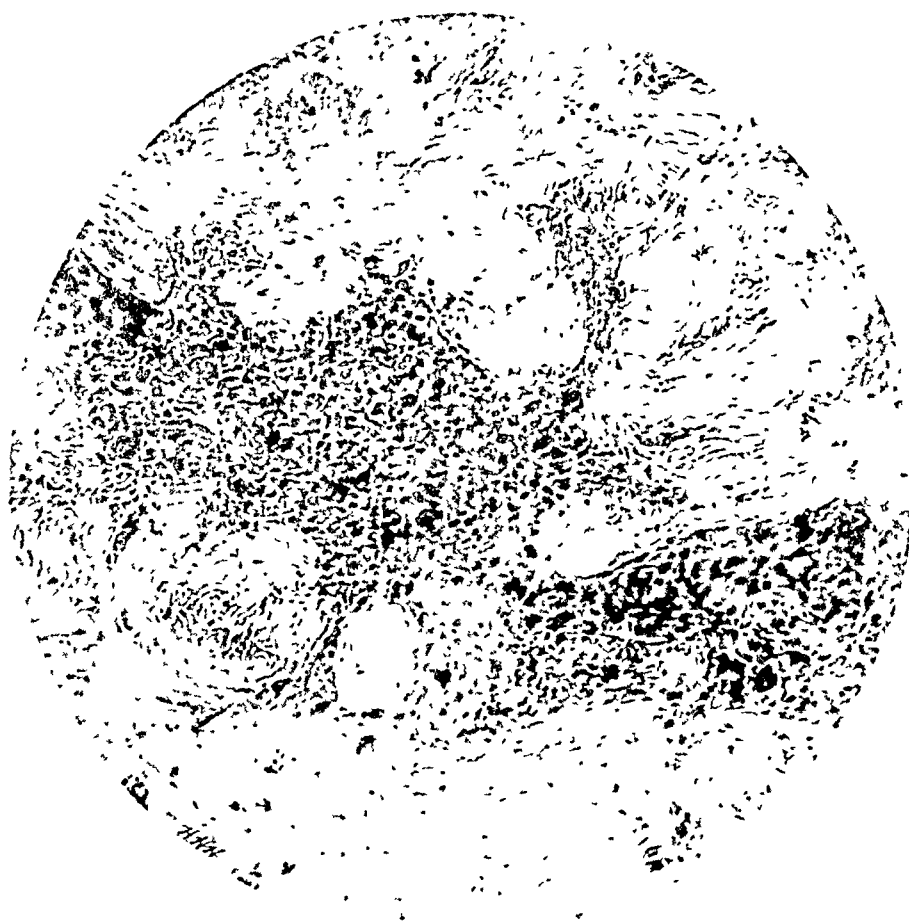


FIG. 3.—Section of carotid tumor (x145).





This tumor was unlike any that I had ever seen, and I expressed the opinion that it might be a growth of the carotid gland.

*Operation* (April 20, 1914).—Ether anæsthesia. An incision was made along the anterior border of the sternomastoid muscle and the tumor exposed, but it was found impossible to remove it until the carotid vessels were ligated below and above the growth. The artery ran through the mass. The pneumogastric nerve was not seen, but it is probable that the recurrent laryngeal was injured. The patient did well and his temperature chart was scarcely above normal subsequently. There was, however, marked alteration in his voice and some inequality of the pupils, which was still present when he was discharged on May 8.

There was no effect apparent on the pulse or respiration when the artery was tied. Apparently the external carotid was absent or had a high origin, as it was not seen during the operation, and nothing resembling it was ligated.

This patient was heard from in December, 1915, and he expressed himself as being well, but still had an impairment of voice.

**PATHOLOGICAL REPORT ON CAROTID TUMOR.**—The tumor is the size of a small egg, measuring 4.4 x 3 x 2.9 cm., weight 17 gms. It has a definite tendency to lobulation and a fibrous capsule. It is irregular in outline, somewhat elastic, fairly dense in consistency, and reddish in appearance. Running obliquely through the tumor, near the periphery, is an artery which permits a small goose-quill to pass through. Radiating over the surface are many small blood-vessels, some of which enter the tumor.

The tumor on section is of reddish gray color, with enough mixture of colors to give it a varied appearance. There seems to be an indistinct arrangement of connective tissue running from the capsule, more or less toward the centre of the mass; the texture and structure between these bands of tissue is of a deeper reddish tint, and is softer in consistency.

*Microscopic Examination.*—Sections including the capsule show it is fibrous in character and that it radiates toward the inner part of the tumor. The majority of cells of the connective tissues are mostly of the elongated variety with indistinct nuclei, and many cells show nuclei of a vesicular character. Other sections of the tumor show a marked increase in the connective tissue with practically nothing but the elongated or spindle-cell present. All sections of the tumor show a large number of small blood-vessels, which, however, are not typical in structure, some occurring simply as blood spaces.

Some of the vessels show beginning hyaline degeneration. The cells are arranged into groups of large and small aggregations and also occur as columns. In different parts may also be seen irregular, small, isolated groups of cells. An alveolar arrangement is also seen in some of the sections. Innumerable spaces, long and short, broad and narrow, contain multiple layers of cells. In some places these spaces seem to be greatly

dilated and are almost entirely filled with cells. All the cellular elements are separated by considerable fibrous connective tissue.

The cells vary in size and shape, and for the most part are irregular polyhedric in outline. The nuclei likewise vary in size, shape, and staining properties. For the most part they are centrally located and surrounded by a fair amount of protoplasm, which is slightly granular. A distinct nucleolus may be seen in some of the cells.

No definite mitotic figures can be distinctly made out.

It is very difficult to be absolutely certain in making the diagnosis of this tumor, and this seems particularly true of the carotid tumors in general. I sent sections to the heads of several pathological departments of the best medical schools and hospitals in the country, and various diagnoses were made. In several instances they would not commit themselves, but rested upon saying "carotid tumor." The following diagnoses of the sections I sent were suggested: "Perithelioma"; "endothelioma"; "sarcoma"; "carcinoma." I believe it to be an endothelioma.

HOWARD J. MALDEIS,  
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These two cases do not differ materially from those that have been reported hitherto, except that the growth in Case I had only been noticed for two months previous to operation, which would suggest a malignant process. If such was the case, however, a radical cure appears to have been attained, as the girl was free from recurrence five years later. The age of this girl is also exceptional for the development of a carotid tumor, as but few cases have been observed as young as sixteen years.

Case II appears to conform more closely to the usual type of cases that have been reported. The patient was a young man, aged twenty-four years, with a slow-growing lump that had been noticed eight years before it became sufficiently large to suggest to him the propriety of a surgical procedure for its removal.

A very interesting phenomenon in the first case was the sudden and prolonged tachycardia that followed the ligation of the carotid vessels. Apparently no injury was done to the pneumogastric nerve to cause a loss of its inhibitive action on the heart. In 1900 I operated on a man, aged seventy-three years, for a secondary growth of the cervical glands, which involved the vessels and nerves of the neck. I ligated and excised the three carotids for a space of several inches as well as the internal jugular and the pneumogastric nerve. At first the heart's action was rapid, but it soon subsided and was not more than 100 subsequently, and when he left the hospital ten days later it was about 85 beats per minute. There was no perceptible influence on the pulse of Case II when the carotid was ligated, and it never exceeded 80 per minute during the time he was in the hospital. In this case the

pneumogastric nerve was not seen, and I do not see how it could have been injured; but he had paralysis of the left vocal cord and post-operative contraction of the left pupil, so that damage must have been inflicted on the nerve itself or, more likely, on the left recurrent laryngeal branch.

Another point of considerable interest in Case II is the fact that while the common carotid artery tunneled the tumor the external carotid was not seen. In 1914 I operated on a woman for angiosarcoma of the skull, and ligated her right common carotid artery. The vessel was exposed for a long distance, and I made a careful search, but nowhere could I find a trace of the external carotid. It is possible that in each of these cases there was a high bifurcation of the common carotid artery.

The carotid body is a small structure situated at, or just posterior to, the bifurcation of the common carotid artery. It is not a gland in the usual acceptation of the term, but appears to belong to the sympathetic nervous system and to the chromaffin group. It is best developed in early fetal life and gradually disappears in later life. If it remains it is liable to develop into a tumor presenting evidences of malignancy. The function of this ganglionic mass is not known. That this structure is prone to evil is shown by the ever-increasing number of cases of "carotid tumor" that are being reported. These cases occur with practically equal frequency in males and females, and are found in almost the same ratio in the decades from 20 to 60. A few cases have been reported under twenty years of age and about an equal number above sixty. The youngest case reported was seven and the oldest seventy-four. The type of tumor is usually endothelioma or perithelioma, which is generally benign or but slightly malignant at first, but if not removed tends to become cancerous.

Able and elaborate papers have been written on this subject by Dr. W. W. Keen in 1906 (*Jour. Am. Med. Assn.*, 1906, xlvii, 469), and by Callison and MacKenty in 1913 (*ANNALS OF SURGERY*, December, 1913), in which all known cases have been collected and tabulated up to that time. Therefore, I have made free use of their statistics, but have collected, as far as possible, the cases that have been reported since their papers were published. Up to 1914, according to Callison and MacKenty, 60 cases of tumor of the carotid body had been observed; since that time 12 cases have been reported, including the 2 herewith presented.

*Symptoms.*—A tumor of the carotid body generally presents no symptoms of a subjective character, though sometimes there may be

either an alteration of the voice from pressure on the recurrent laryngeal nerve, cough, slight dysphagia, radiating pains, or a sense of discomfort or tenderness. Usually the patient seeks advice on account of a slow-growing lump in the upper part of the neck, which has either taken on a more rapid growth or has increased gradually to such an extent as to produce deformity and to cause embarrassment. Occasionally the growth is rapid from the start, but there is generally the history of a lump that has been in existence for several years. By the time the growth has attained a size sufficient to attract attention it is as large as a pigeon's egg or a hen's egg. The tumor is ovoidal or egg-shaped, and is single and usually occurs on one side only, though at least three cases of bilateral carotid tumor have been reported. The tumor is found opposite the thyroid cartilage and may extend upward toward the base of the skull or downward toward the clavicle. It is firm, smooth, movable laterally but not vertically, and sometimes has an upheaval pulsation and a bruit and thrill from its relation to the carotid vessels. Some observers have thought that there was an actual expansile pulsation, but this is not probable. The growth is encapsulated and does not infiltrate the surrounding tissues unless its malignancy is far advanced. At times there is an irregularity of the pupils from pressure on the cervical sympathetic ganglia.

*Diagnosis.*—This condition has been diagnosed before operation only a few times, but it is being recognized more frequently as its clinical features are becoming better known. In the case under my care I made a tentative diagnosis of carotid tumor, though I was by no means sure that such was the case until I saw its relation to the carotid artery. It has been mistaken most frequently for a tuberculous lymph-node, aberrant thyroid, carcinoma or sarcoma of the glands, as well as for various other conditions.

A single, slow-growing, firm, smooth, discrete, usually painless oval lump, more or less fixed, situated in the superior carotid triangle opposite the thyroid cartilage and anterior to or under the sternomastoid muscle, should always cause us to suspect a neoplasm of the carotid body.

*Treatment.*—Although Keen, in 1906, made the statement that unless the tumor is growing rapidly and presents evidences of malignancy it should not be removed, and Da Costa declared that he would not operate on another case, which resolution he promptly broke, I do not think there can be much diversity of opinion that these tumors should be treated, as are other actual or potential malignant neoplasms, by early and complete extirpation. The operation, however, should not

be approached lightly, as it may prove both difficult and dangerous. In most cases it will be necessary to ligate and excise one or more of the great vessels of the neck, and sometimes, either by accident or of necessity, some of the important nerve trunks, as the pneumogastric, hypoglossal, or sympathetic, may be cut or injured, thereby adding to the gravity of the procedure.

In some cases it is possible to dissect the tumor from the vessels without injuring them, which, while lessening the immediate mortality certainly adds to the probability of recurrence. In view of the fact that cases have been reported free from recurrence several years after the removal of the tumors by dissection, without ligation or excision of the arteries, I think we are justified in using this method in suitable cases.

The ligation of the common carotid artery is in itself a serious operation, and in many cases there is disturbance in the cerebral circulation that either terminates fatally or leaves the patient with paralytic symptoms. In a personal case, some years ago, I was obliged to ligate and excise the common and internal carotid arteries while removing a carcinomatous mass in the neck. The patient never regained consciousness, and died hemiplegic on the third day thereafter. Of the cases of carotid tumor operated on that have been reported, hemiplegia occurred seven times with two deaths and five recoveries. The cerebral complications, however, are not the only ones to add gravity to the operation. In several cases reported the tumor itself has been excessively vascular and the immediate hemorrhage has been severe, and in three cases death resulted from hemorrhage. Injury to the large nerves of the neck, either by accident or by design, occurs with considerable frequency, the most serious being the division of the pneumogastric. In four cases that terminated fatally from pneumonia the vagus was found to be cut in each. The hypoglossal nerve has also been divided in several cases, with subsequent partial paralysis and hemiatrophy of the tongue; but this is not a matter of great gravity. Division of the recurrent laryngeal nerve may occur and will leave the patient with a paralyzed vocal cord and huskiness of voice. In one case there was a constant cough after operation. Minor ill-effects, such as partial facial paresis from injury to twigs of the seventh nerve and inequality of the pupils from damage to the sympathetic, are sometimes noticed. In fact, of the total number of operations for removal of carotid tumors in only a few cases were no nerve injuries observed. Keen says that only 7 out of the 26 cases of removal of carotid tumors tabulated by himself were free from nerve symptoms subsequently.

*Mortality.*—I have knowledge of 64 cases operated on for tumor

of the carotid body, of which 5 were exploratory in character, leaving 59 in which the tumor was removed. Of 26 extirpations tabulated by Keen 7 were followed by death, or 27 per cent. mortality. Callison and MacKenty's statistics give 12 deaths in 50 removals, or 24 per cent., while there has been no immediate mortality in the cases reported during the past two years. Leaving out of consideration the uncompleted or exploratory operations there have been 59 cases in which the tumor has been extirpated, with 12 deaths, or a mortality of 20 per cent. As this is a material lessening of the mortality, it indicates either a better selection of cases for operation or an improvement in technic in dissecting the growth free instead of ligating and excising the great vessels. In 34 cases reported either all three carotids or the common and internal carotid arteries were ligated and excised, with 11 deaths, or nearly 33 per cent. fatality, but only two or three recurrences are noted. The ligation and excision of the external carotid artery alone does not seem to be attended with any special danger, and in a number of cases where the tumor has been removed by dissection the external carotid has been ligated also.

In 25 cases in which the common and internal carotids were not ligated, 24 recovered from the operation and only 1 died, but speedy recurrences occurred in 8 cases. It is probable, however, that several of these cases would have recurred after removal by any other method. It is an interesting fact that a case explored and considered inoperable by Holloway was living six or seven years subsequently; and several cases have been reported in which a tumor had been in existence from twenty to thirty-seven years previous to removal. In view of these facts we seem to be between Scylla and Charybdis. If we excise the carotid vessels with the tumor we have a large mortality from cerebral complications, but those patients who survive usually do not have recurrence of the growth; if we dissect the tumor free from the vessels the immediate mortality is small, but the tendency to recurrence is great. In such matters an operator decides upon the procedure to be employed according to his best judgment at the time of the operation. In my opinion the tumor should be removed by ligation and excision of the carotids, unless it is only very loosely attached to the vessels.

In 1906 Keen and Funke (*Jour. Am. Med. Assn.*, xlvii, 469) collected 29 cases of "carotid tumors," and in 1913 Callison and MacKenty (*ANNALS OF SURGERY*, lvi, 740) were able to find reports on 31 additional cases. In a by no means exhaustive search of the literature I have been able to find reports of the following cases not hitherto tabulated:

1. LEVINGS (*Wisconsin Medical Journal*, xii, 17): Man, aged sixty-eight years, growth only three weeks in duration following an injury; size of goose egg and growing rapidly.

*Operation.*—Internal jugular involved and excised, tumor dissected from carotids. Recovery from operation and death from recurrence in four and a half months. Diagnosis was not made previous to operation.

2. BALFOUR and WILDNER (*Surgery, Gynecology and Obstetrics*, March, 1914, p. 203): Woman, aged thirty-four years, suffering with adenoma of thyroid, causing pressure symptoms and paralysis of right vocal cord.

April 5, 1913, under ether narcosis, the right lobe of the thyroid was excised, then a separate mass the size of a lemon was found in the right submaxillary region, at first thought to be an aberrant thyroid. Very adherent to surrounding tissues and intimately connected with the deep vessels. Internal jugular invaded and excised for four inches; vein filled with tumor mass. Carotid vessels not ligated. Convalescence rapid; left hospital on sixth day; subsequently developed hemiplegia, which persisted, and recurrence was thought to have occurred.

3. HOLLOWAY (*Southern Medical Journal*, vii, 557): Woman, aged thirty-five years; multipara; some dysphagia and choking; tumor size of walnut. Operation undertaken and discontinued on account of hemorrhage. Patient recovered from operation and was still living six or seven years subsequently.

4. SCHMIDT (*Beitrag zur klin. Chirurg*, lxxxviii, 301): Operator, Prof. Enderlen. Woman, aged fifty-two years, noticed lump on left side of neck for twenty years, growing rapidly for three months; now size of a hen's egg. Slight sticking pain and loss of weight. On right side of neck there is a much smaller lump in the upper carotid triangle.

Operation on left side under local anæsthesia. Large cavernous vessels overlying the tumor caused severe bleeding. External carotid ligated; common and internal carotid excised and the cut ends brought together with sutures. No disturbance of brain followed. Tongue on left side became atrophic and its protrusion lessened, indicating an injury of the hypoglossal nerve.

After seven weeks the right side was operated and the tumor dissected from vessels without injuring them. Patient well and free from recurrence a year later.

5. JOPSON and KOLMER (*ANNALS OF SURGERY*, lx, 789): Woman, aged twenty-seven years; March 19, 1913; growth the size of a pigeon's egg; two months in duration. No special symptoms; lump movable and painless. External carotid artery ligated but not the internal or common; no nerves injured. Discharged, cured, in eleven days. Pathological diagnosis: Perithelioma of carotid gland, chromaffin cells found. Diagnosis not made previous to operation.

6. COLLIER (*Surgery, Gynecology and Obstetrics*, April, 1915, p. 484): Woman, aged fifty years; slowly growing tumor, the size and shape of a large walnut on the left side; five years in existence; of dark reddish brown color. No symptoms except a sense of fulness in the neck. Operation under ether. Three carotids ligated; nerves not injured. On second day œdema of larynx, hoarseness, paralysis of left vocal cord. Recovered and left hospital in sixteen days. Voice normal in six months.

7. OWEN (*ANNALS OF SURGERY*, lxi, 382): Colored soldier, U. S. Army; growth on left side, size of an egg; one year in duration; painless; slightly



## RANDOLPH WINSLOW

movable; slight pulsatile upheaval; slight dysphagia: Tuberculosis and syphilis negative to tests.

*Operation* (March 19, 1914).—Ether anæsthesia. Tumor in the bifurcation of the carotid vessels; of bluish color and vascular. Dissected free from arteries; free bleeding controlled by clamps and packing. No complications ensued.

Man returned to duty in one month, well. Diagnosis: "Endothelioma from an intracarotid rest."

8. WILLIAM PERRIN NICOLSON, Atlanta, Ga. (personal communication): Mrs. C., white, aged forty-three years, housewife. Consulted Dr. Nicolson in May, 1914, for a large tumor of the neck. This began nine months before as a small movable tumor in the side of the neck, which was supposed to be an enlarged gland, and was so treated. The increase in growth had been gradual, and produced no special disturbance until recently, when the pressure symptoms began to give distress. Within the last month or two a small movable growth, much like the original, has appeared upon the other side of the neck.

Examinations showed the left side of the neck completely blocked by a very large tumor, which was practically immovable. It extended from just above the clavicle to the base of the skull, and the median side had pushed the trachea and larynx to the right of the middle line, while externally the edge of the growth was well overlapped by the trapezius muscle. The growth was clearly of a sarcomatous nature and a gloomy prognosis was given, and the operation distinctly discouraged. In spite of this the patient appeared the same afternoon at the hospital, and, in face of the discouraging outlook, asked for operation, which was performed May 16, 1914. The external border was first attacked, as being in less dangerous territory, and was finally with much difficulty lifted from under the border of the trapezius muscle, after the sternocleido muscle had been cut. At the inner side of the growth there was an intimate adherence to the thyroid gland, and above to the submaxillary, both of which were spread over the internal and upper edge of the tumor, so that a part of each gland was left attached to the growth. When the trachea was separated it was found to be deflected much to the right side of the median line. Finally the point was reached when by blunt dissection the fingers could meet under the growth and in front of the cervical spine.

In proceeding to release the lower pole of the tumor it was discovered that a rounded cord entering it contained the carotid vessels, and for the first time the character of the growth was discovered. This was clamped and cut through with scissors, the immediate effect of which was very alarming, and from this time on there was much disturbance of both respiration and circulation, and a number of times work had to be suspended. The upper pole of the tumor was so tightly jammed under the skull that it could only be removed by clamping the vessels behind, and cutting it away with curved scissors. The two carotids were quickly clamped and tied, as both were bleeding from the distal ends; but it was necessary to sew over the internal jugular vein at the jugular foramen, as there was not sufficient space to tie the vessel. A deep trough, extending from the base of the skull to the clavicle, bounded behind by the vertebral column, free from sympathetic and covered by the glistening tendon, of the rectus capitis anticus major. At times during the operation the pulse registered above 160,

## TUMORS OF THE CAROTID BODY

but at the conclusion there was no serious shock. The time was one hour and forty-five minutes.

The physiological storm that followed for a week or ten days was very interesting. The typical laryngeal paralysis reduced the voice to a whisper, and there was practically complete paralysis of deglutition, fluids gushing back when attempts were made to swallow, accompanied by violent strangling and coughing. A severe bronchorrhœa developed in the left lung, and there was great difficulty in getting rid of the tenacious mucus. The pulse ranged as high as 150 at times, and the left side of the face and the left eye were intensely suffused with blood. Fortunately all of these symptoms gradually improved, and she became more comfortable, and three weeks after the first operation, attention was directed to the tumor upon the right side, which we had by this time become satisfied was also a carotid tumor. It was about the size of a large olive, movable from side to side, but could not be lifted up or moved upward or downward. The location corresponded with the bifurcation of the common carotid artery.

The patient, after discussing the dangers connected with its removal, consented to the operation, and, on June 5, the operation was undertaken. The tumor was easily reached on its anterior aspect, being covered only by the superficial structures, but on each side it was very intimately attached, requiring a careful and rather disturbing dissection. It was also very tightly attached at its lower pole, but when a line of cleavage was secured, instruments were abandoned, and the under surface was detached by peeling it away with the finger-nail. Finally it came away, leaving the vessels intact, and a sigh of relief came from all. Not a vessel had been ligated, and the small wound was closed with catgut and covered with a collodion dressing. In the meantime everything but the hoarse voice and the difficulty in swallowing had ceased, and the latter gradually improved. Even at this time a thickening began over the right side of the neck, and in five weeks after leaving the hospital the patient returned, with a distinct and rapid recurrence. She was put upon the Coley fluid, with a negative result.

Four months after the first operation the end came. At the site of the smaller tumor there was no recurrence, but it was evidently impossible to remove all the diseased structures.

9. DA COSTA (*New York Medical Journal*, xcix, 253): Woman, aged forty-eight years; six children; has had trouble for eight months. Has bilateral tumors, each the size of a hen's egg. Some dysphagia and change of voice. Has lost 30 pounds in eight to ten months. No operation was done and the woman died a few months later.

Post-mortem examination revealed the tumors to be malignant growths of the carotid gland, of the type of perithelioma.

10. SAPEGNO (*Archiv. med. Turin*, xxxvii, 367) reports the findings at autopsy in the case of a woman, aged sixty-four years; apparently no operation was done.

# TRANSVERSE INCISIONS IN THE UPPER ABDOMEN \*

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UP to the year of 1910 it was my custom in operating upon the gall-bladder, or biliary passages, to make a vertical incision through the outer third of the right rectus abdominis, with separation of the muscle fibres. The average length of the incision was three or four inches. The incision was extended in one or both directions, when unexpected difficulties were encountered. If still more room was required in an upward direction, and none was obtainable on account of the encroachment upon the free border of the ribs, the incision was continued in an upward and inward direction, with transverse, or, better said, oblique division of the fibres of the rectus; so that in these cases the incision ultimately resembled that known in general as Körte's incision. These incisions as a rule gave ample exposure for all the required manipulations, notably simple cholecystectomies. I have always made an effort to close the incision by a layer suture; the first, a continuous suture line, included the peritoneum, transversalis fascia, and posterior sheath of the rectus; a few interrupted sutures then lightly approximated the separated fibres of the rectus; the third suture line of interrupted, rather heavy, chromicized catgut, included the anterior sheath of the rectus; and, finally, the skin was closed by either silk sutures or Michel clips.

The technic of suturing such a wound is self-evident, and to the uninitiated apparently very easy; very frequently, however, almost insurmountable difficulties arose, especially in the application of the first suture line. In most of our operations, particularly if the patient is very obese or very muscular (and in parenthesis, I may add, that fully 90 per cent. of the gall-bladder patients at my hospitals belong to the former group), the suture of the peritoneum was extremely difficult. The stitches tend to cut through; to overcome this tendency one is inclined to include more tissue in the bite of the needle; unfortunately this procedure not only does not mitigate the difficulty, but actually increases it.

After a great deal of trouble, and with considerable loss of temper, the surgeon finally succeeds in finishing the suture line; the result, how-

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\* Read before the American Surgical Association, May 11, 1916.

## TRANSVERSE INCISIONS IN THE UPPER ABDOMEN

ever, is not satisfactory; the suture line is weak, and there are generally present also a number of smaller or larger holes, which permit the prolapse of small bits of omentum. In the greatest majority of the cases this suture line is so precarious that its protective value is *nil*. It is of course possible that it acts as a prophylactic to the formation of adhesions, by preventing contact between the intraperitoneal viscera and the extraperitoneal tissues. But even this is, I believe, illusory; as in the secondary operations that have fallen to my lot, I have found the adhesions to be so massive as to lead me to suspect that the suture line gave way upon the first strain, and not only permitted, but actually invited, the contact, which it was presumed to prevent. In this connection it is of great interest to know, that Sprengel found at autopsy, in a few cases which died shortly after a laparotomy through a vertical incision, that the peritoneal suture line had completely separated.

In a very large number of cases even this flimsy closure was impossible, and after vainly trying to fortify the first suture line, by including a part of the rectus, the attempt at a layer suture was very frequently given up in disgust, and the wound had to be closed practically *en masse*, the first suture line including the entire thickness of the abdominal walls, with the exception of the skin. I have often said on such occasions that by far the most difficult part of any operation upon the gall-bladder or biliary passages is the closure of the abdominal incision.

As this incision through the upper part of the rectus is, to my knowledge, the incision in greatest favor with most American surgeons, it is somewhat surprising that expression of similar dissatisfaction has not found its way into medical literature more frequently. Up to a few months ago I was even under the impression that my experience was unique, but in the September, 1915, number of *Surgery, Gynecology and Obstetrics*, I read that Robins has experienced a similar difficulty, duplicated a few months later by Green, in the March, 1916, number of the *ANNALS OF SURGERY*, which has induced both authors to devise an improved method of suturing.

This condition of affairs rendered me, therefore, very receptive to suggested improvements, and in consequence I paid more than casual interest to the striking article of Sprengel, in the *Archiv f. klinische Chirurgie*, vol. xcii, p. 537. Sprengel realized the difficulties I have mentioned above, and set out to study the reasons for the difficulties, and was ultimately able to evolve a new, but nevertheless correct, principle in abdominal incisions. It is necessary to state, however, that the rules that have been dictated by surgical principles in the past were also correct; but it is strange that surgeons have universally violated

these rules by the conventional abdominal incisions. It must be insisted that the credit which Sprengel deserves is not that he invented new principles but that his incisions were the first to correctly conform to those that have hitherto been recognized.

I essayed a transverse incision almost immediately after the appearance of Sprengel's article. My first operation is dated August 2, 1910, or almost six years ago. In the beginning I was somewhat diffident, and used the transverse incision only sporadically; my satisfaction, however, has been so great, that I am now using the incision with much greater frequency.

The correctness of the principles involved in transverse incisions will be discussed under the following two headings: I. The anatomy and physiology of the abdominal parietes. II. The surgery of the abdominal parietes.

#### I. THE ANATOMY AND PHYSIOLOGY OF THE ABDOMINAL PARIETES

The anatomy of the abdominal walls is simple; so simple, indeed, that it is easily forgotten. I trust, therefore, I will be pardoned, if I recall to your mind a few of these simple, but highly important, data.

The anterior abdominal wall is made up laterally of three flat muscles—the external and internal oblique, and transversalis muscles, and, centrally, the rectus abdominis. The three former, having various points of origin upon the sides and back of the trunk, finally terminate in the median line of the abdomen, by a broad aponeurotic expansion, which joins and interlaces with a similar aponeurotic expansion of the opposite side, and forms the linea alba. These aponeurotic expansions of the muscles are analogous to an ordinary tendinous termination of a muscle, and have an absolutely identical physiological function, namely, to become taut upon contraction of the muscle fibres. In other words, such an aponeurosis attached to a muscle acts really as if the muscle would terminate in a multitude of fine little tendons.

In previous articles, particularly when discussing the pathogenesis of hernia, I have frequently pleaded for the use of certain accepted anatomical names. I do so again, and this time my reasons are even more important than heretofore. Very frequently the word "fascia" is carelessly used, when in reality "aponeurosis" is meant. In the indiscriminate use of these words, one forgets that the physiological functions of fascia and aponeurosis differ widely. The function of fascia is to form a septum between two structures, while that of the aponeurosis is to follow the contraction of a muscle. If the latter function is borne in mind, we will, I believe, learn to regard the aponeurosis of the

## TRANSVERSE INCISIONS IN THE UPPER ABDOMEN

anterior abdominal wall with greater respect than we are occasionally in the habit of doing.

While all these muscles have the same line of insertion, their points of origin are quite different; this would also render the direction of their force somewhat different; the difference, however, is so slight that, in view of the fact that the origin of all these muscles is upon the lateral and posterior aspects of the trunk, the general direction of the force must also be in a lateral direction.

The remaining integral components of the abdominal wall, namely, peritoneum and transversalis fascia, do not at the present moment call for extensive description. It is of some importance, however, to remember that the transversalis fascia is very delicate in the upper parts of the abdomen. It follows, therefore, that the peritoneum, transversalis fascia and posterior sheath of the rectus are inseparably welded together, and that consequently a separate suture of the peritoneum is a physical impossibility.

The peculiar arrangement just mentioned, and more particularly the resemblance of the several aponeuroses to a multitude of horizontally running little tendons, is of threefold importance in surgical technic. First, that an incision in a vertical direction will necessarily divide at right angles a large number of the small tendon-like terminations of all the three muscles; second, that after such division, the muscles when contracting will have a tendency to pull the wound more and more apart, and they will continue to do so, even after the incision has been carefully sutured; and third, that it increases very materially the difficulties in closing the wound, because the direction of the pull of the sutures is parallel with the tendon fibrillæ, and parallel also with the direction of the pull.

That this is not a fanciful theory, advanced merely as an argument to prove my contention, but an actual fact, will be verified by the experience of any surgeon of an inquisitive mind, and more particularly of those who frequently make use of the so-called Kammerer incision. In order to prove my statement it is necessary to first call attention to the difference in the arrangement of the aponeuroses of the abdominal muscles above and below the so-called semilunar fold of Douglas. As is well known, the aponeurosis of the transversalis muscle and the posterior leaf of the aponeurosis of the internal oblique pass behind the rectus muscle above the semilunar fold of Douglas (Fig. 1), while below the semilunar fold all the aponeuroses pass in front of the muscle (Fig. 2). Assuming now my previous contention to be true—namely, that the difficulty in suturing the peritoneum in a vertical incision is due,

first, to the peculiar aponeurotic termination of the flat abdominal muscles, and, second, to the intimate blending of the peritoneum with the posterior sheath of the rectus—it follows that the suturing ought to be easy wherever the peritoneum is not attached to these aponeuroses. Peculiarly both the positive and the negative sides of my contention are

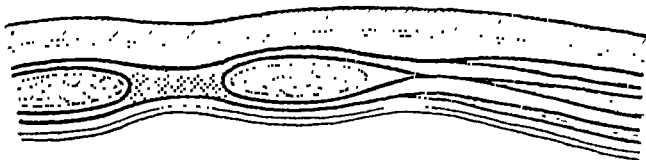


FIG. 1.—Transverse section of the anterior abdominal wall above the semilunar fold of Douglas.

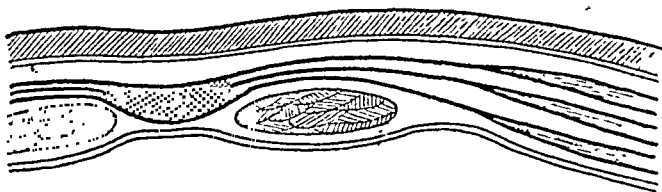


FIG. 2.—Transverse section of the anterior abdominal wall below the semilunar fold of Douglas.

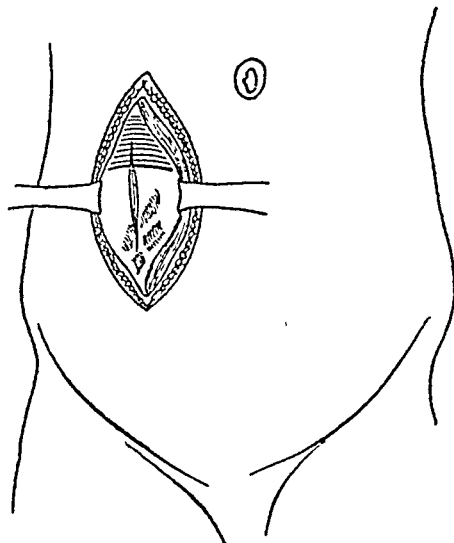


FIG. 3.—A Kammerer incision extending above the semilunar fold of Douglas.

proven perfectly by the Kammerer incision (Fig. 3). We find, in fact, that suturing below the semilunar fold of Douglas is perfectly easy, but, whenever the incision extends above the semilunar fold of Douglas, the suture will be as difficult as in an incision higher up; for instance, in the region of the gall-bladder.

Let us now assume for the sake of argument, that there is no such

## TRANSVERSE INCISIONS IN THE UPPER ABDOMEN

muscle as the rectus abdominis, and that the space normally covered by the two recti is occupied only by the aponeurotic expansion of the three lateral flat muscles; and let me furthermore assume, that the space above alluded to would be much wider and much shorter than it really is; does it not also follow, that a correct surgical incision of the abdomen must be in a transverse, and not in a vertical, direction? And yet we find that, excepting Sprengel and his few followers, most surgeons make their incisions in a vertical direction. To my mind this can be due only to one of the following reasons: that a longitudinal incision parallel to the greater length of the trunk seems to be a more cosmetic one; or a fear

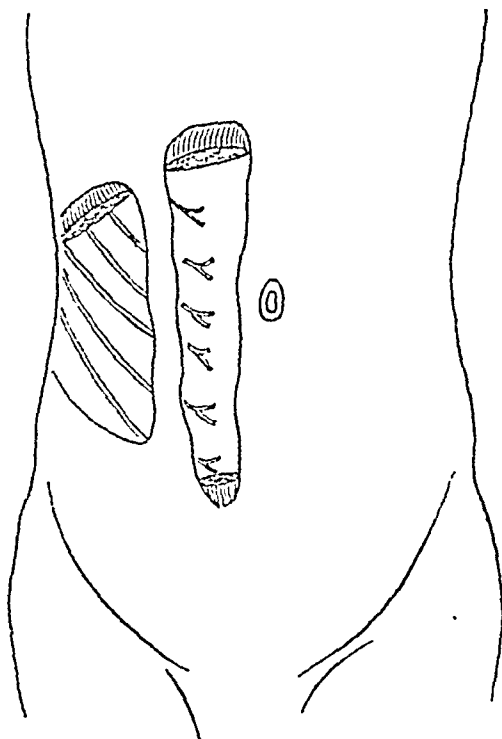


FIG. 4.—Diagram illustrating the nerve supply of the anterior abdominal wall.

of dividing transversely the presumably very important rectus abdominis; or the inviting ease with which the abdomen can be opened; or a simple passive acquiescence in conventional methods; or perhaps a combination of these reasons.

I also believe that much of the confusion is due to the name, "sheath of the rectus," which has been given by anatomists to this part of the aponeuroses of the three lateral flat muscles of the abdomen, because one is involuntarily inclined to look upon the "sheath of the rectus" as an integral part of the muscle, and that therefore its action and direction is dependent upon the muscle. As a matter of fact, the reverse is true; the



rectus muscle is attached only anteriorly to the sheath, and even here only at the three so-called lineæ transversæ; while its attachment to the posterior sheath is very loose, and readily broken up. The lineæ transversæ before mentioned do not penetrate the entire thickness of the muscle, but merely its anterior third or half. They, however, serve quite adequately to subdivide the rectus into comparatively short segments. As these segments have independent nerve supplies, it follows also that injuries to the muscle are confined at most to one particular segment, and do not influence the entire length of the muscle. This is of some importance to surgeons who practise transverse incisions, inasmuch as the gap caused by transverse division of the muscle in a particular segment is not near as large as it would be if it were pulled apart by the entire length of the muscle. Furthermore, it also follows that such a gap is very readily approximated, and, after healing has taken place, the final result represents merely an additional linea transversa.

All vertical incisions of the abdomen, except those made exactly in midline, violate another very important rule of surgical incisions, or at least run great danger of violating it, namely, that they come into conflict with the nerves supplying the rectus abdominis. These nerves, as is well known, enter the sheath of the rectus laterally and have in general a transverse or slightly oblique direction (Fig. 4). They are therefore exposed to injury by every vertical incision. On the other hand, a transverse incision runs parallel with the nerves, and consequently the risk of injury is only very remote.

## II. THE SURGERY OF THE ABDOMINAL PARIETES

The requisites of a correct surgical incision may be discussed under the following headings, in the order of their occurrence. (1) Ease of execution, as far as "getting in" is concerned. (2) Amplitude of exposure. (3) Ease of execution, as far as "getting out" is concerned. (4) Post-operative comfort. (5) Cosmetic results. (6) Late results.

### (1) *Ease of Execution, as Far as "Getting in" is Concerned.*—

Although this paper is written to advocate transverse incisions, I can best discuss the above heading by exposing the relative advantages and disadvantages of the vertical and transverse incisions. In general it is agreed that the easiest, and at the same time also the quickest, way to enter the abdomen is by means of a longitudinal incision in the linea alba; no structures of great importance are encountered, and practically no vessels require ligation. Next in ease of execution are longitudinal incisions to the right or left of the median line, with blunt separation of the fibres of the rectus; in the lower half of the abdomen the deep

## TRANSVERSE INCISIONS IN THE UPPER ABDOMEN

epigastric vessels, in the upper half the superior epigastric vessels may be injured, but can be readily controlled; if the incision crosses one of the tendinous inscriptions of the rectus, a few additional transversely running vessels may require ligation. Care must be exercised not to divide the nerves which enter laterally, but as a rule they can be retracted unless the incision is very long. Next in ease of execution are the incisions modelled after the Kammerer incision, with retraction of the rectus either toward or away from the median line; a slight delay may occur in liberating the anterior sheath of the rectus and its outer

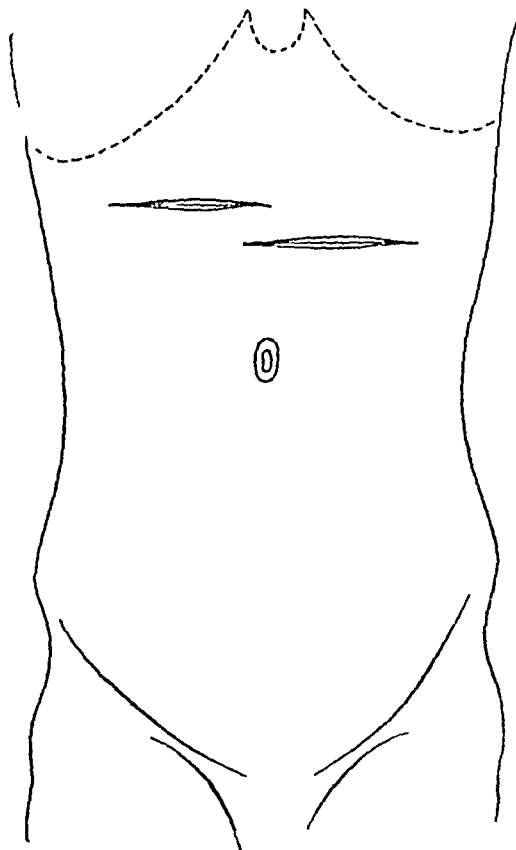


FIG. 5.—Two transverse incisions in the upper abdomen.

margin, at a tendinous inscription. All in all, these incisions are very simple, and can be rapidly carried out; candor compels me to add, that compared to these incisions, a transverse incision is quite a complicated surgical procedure.

Theoretically, the making of a transverse incision is very simple; everything is divided in a transverse direction;<sup>1</sup> in practice, however,

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<sup>1</sup>It must not be forgotten, however, that the word "transverse" is used here to denote an incision at right angles to "vertical." In fact, only the rectus muscle is divided transversely, while all the other structures are in reality divided longitudinally.

the procedure is not quite so simple. Let us assume, for instance, that the incision is to be very short, say one for exploratory purposes, or through one rectus only (Fig. 5). Whereas vertical incisions do not bleed at all, or only slightly, the bleeding in transverse incisions may be annoying. The vessels run parallel with the muscle fibres, and within the substance of the rectus abdominis, so that if cut the vessels retract with the muscle fibres; they are caught only with difficulty, and, when caught, their ligation is not at all an easy matter.

If the incision is to be longer, and the median line has to be crossed,

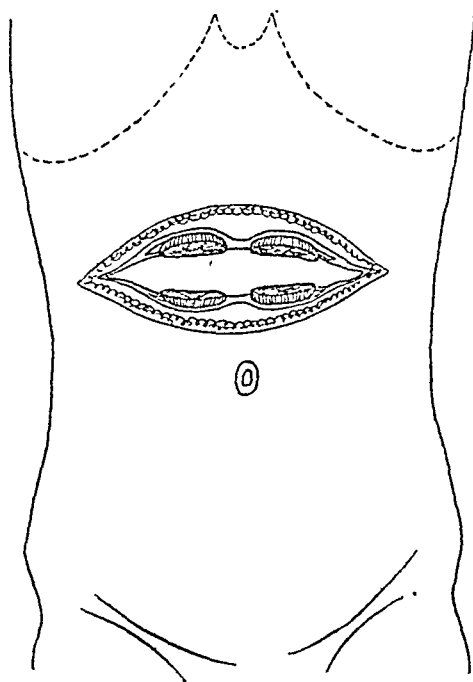


FIG. 6.—Transverse incision through both recti.

we are likely to come into conflict with the round and falciform ligaments of the liver. Occasionally the umbilical vein running within the round ligament is not completely obliterated, and if carelessly divided may be the source of annoying primary or secondary hemorrhage. It is therefore best to take care of it in every case, by preliminary transfixion and ligation. The rectus of the opposite side is now divided to the necessary extent, again encountering and dealing with branches of the superior epigastric vessels. A complete incision with division of both recti would therefore have the above appearance (Fig. 6).

Both Sprengel and Bakes advocate a method which differs somewhat from the preceding. They wish to avoid a division of the second rectus,

## TRANSVERSE INCISIONS IN THE UPPER ABDOMEN

and attain this by a sharp division of both the anterior and posterior sheaths, while the muscle itself is merely retracted (Fig. 7). I have attempted to do so in a few cases, but found a very strong tendency on the part of the rectus to tear; on that account, and also because I do not fear any more a transverse division of the rectus, I have abandoned the method, and now boldly incise the second rectus for the requisite length.

Transverse incisions in the upper part of the abdomen are useful in all operations upon any organ in that location. They are particularly indicated in operations upon the stomach and gall-bladder. It is with some regret, therefore, that I see Sprengel describing an incision for

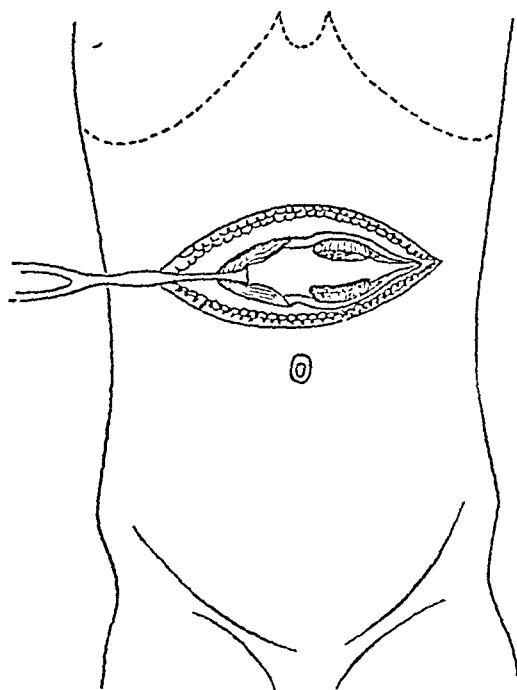


FIG. 7.—Sprengel incision with retraction of one rectus.

operations upon the gall-bladder, which is not *sensu strictu* transverse, because it runs parallel with the free border of the ribs, ends in a hook at its outer extremity, and then runs upward and outward parallel with the external oblique. The disadvantage of this incision is, that it is more liable to injure some of the nerves supplying the rectus. I have therefore never adopted this particular recommendation of Sprengel, but use with the greatest satisfaction for all gall-bladder operations a straight transverse incision. Incidentally, I may add that Bakes practises the same incision as I.

Surgeons, when first attempting a transverse incision, rather fear a complete transverse division of the recti, because they expect that an

unclosable gap will result thereby. Soon after Sprengel first described the method, modifications were proposed in order to prevent this contingency. I mention particularly Perthes (*Zentralblatt f. Chirurgie*, 1912, p. 1251), who advises a double transverse line of sutures (Fig. 8) to attach the rectus to its sheath. As Perthes feared that in applying these sutures the needle might penetrate the abdomen and injure an underlying viscus, he advised to first open the peritoneum at the linea alba, and then to use a finger introduced through this button-hole as a guard (Fig. 9). Long before I knew of this method I also made use of transverse sutures, but have never seen any injury, provided a little

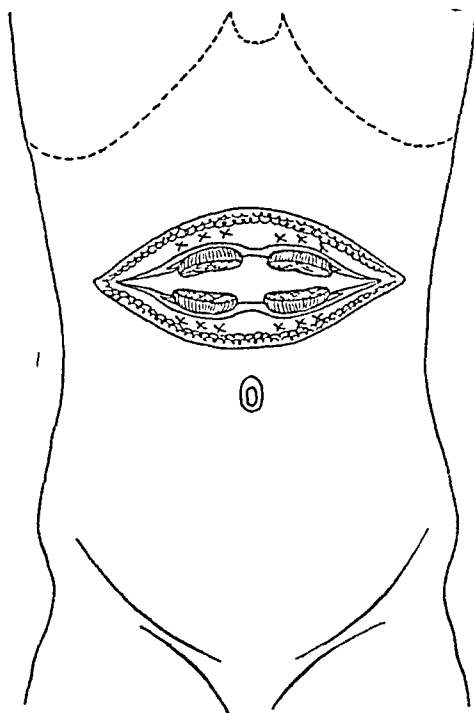


FIG. 8.—Double transverse sutures to fasten the rectus to its anterior sheath.

care is used. I believe, however, that the great advantage of these sutures is not because they prevent retraction of the rectus, but because they act as a very efficient prophylactic hæmostat. I therefore continue to use some such suture line, and find that the time apparently lost in their introduction equalizes itself by the gain in time when the vessels do not have to be caught and ligated individually.

In conclusion I wish to assert most emphatically, that I have purposely gone into the minutest details in describing the technic of making a transverse incision, and have really exaggerated the disadvantages, because, barring those enumerated, everything else is absolutely in favor of the transverse incision.

## TRANSVERSE INCISIONS IN THE UPPER ABDOMEN

(2) *Amplitude of Exposure.*—In the upper part of the abdomen I prefer an incision approximately two inches above the umbilicus; this may therefore be called my “normal” incision. The incision divides, first, either the right or the left rectus, depending upon the diagnosis of the case. As a general rule, the incision is made through the right rectus for all operations upon the gall-bladder and biliary passages, and through the left rectus for all gastric operations. I may also add, that by dividing the right rectus alone, ample exposure is obtained for a cholecystectomy, my operation of choice in cases of cholelithiasis; but in the complicated operations upon the hepatic or common ducts I do

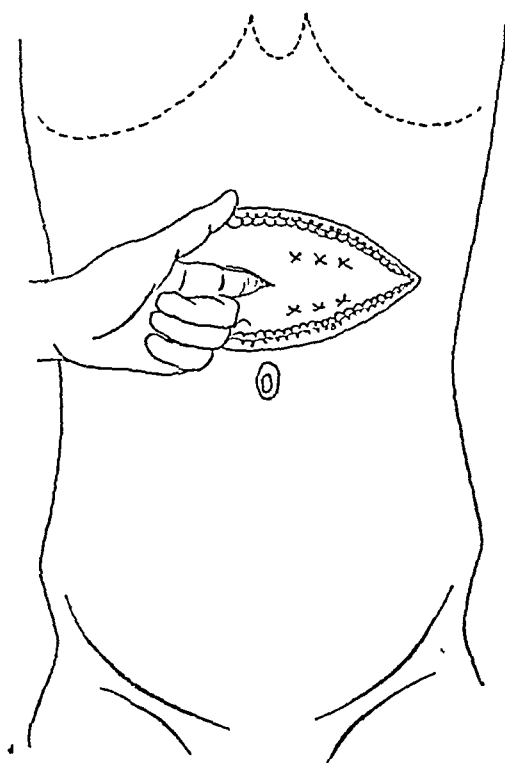


FIG. 9.—Method of Perthes of introducing the double transverse line of sutures.

not hesitate to also divide a part of the left rectus. Similarly, an ordinary gastro-enterostomy, with or without exclusion of the pylorus, can be done with ease by dividing only the left rectus; but in a pylorectomy for carcinoma with adhesions, or in excisions of ulcers upon the lesser curvature, perhaps high up near the cardia, I do not hesitate to extend the incision so as to also divide a part or whole of the right rectus. In no instance in my experience did I find any necessity to curve my incision upward or downward.

The exposure obtained from such an incision is beautiful; above all it should be noted, that even when the patient strains, the stomach and

intestines stay in the abdomen, and but very little packings are required to keep them so. I have frequently finished a gastro-enterostomy without having a single packing within the abdomen. The doing away with packings ought to be particularly welcome, because it doubtless aids in preventing many post-operative adhesions. I absolutely cannot agree with Kehr (*Archiv f. Klinische Chirurgie*, vol. xcvi, p. 74), who in condemning transverse incisions uses as one of his arguments the necessity of many packings. In view of my experience, this argument of Kehr is so surprising that I simply cannot account for it on any reasonable grounds. As it is, many of the arguments advanced by Kehr in favor of his "Wellenschnitt," and in opposition of all transverse incisions, such as ability to operate with only one assistant, the avoidance of instrumental retractors, the ability to use massive tamponade (it is well known that Kehr has very peculiar ideas regarding the after-treatment, which are not shared by many surgeons), are strange, to say the least.

In cases of obscure diagnosis, or when the incision is made for the purpose of exploration only, transverse incisions in the upper abdomen are particularly advantageous; by extending the incision in one or another direction, any operation on any viscus in the upper abdomen may be undertaken, obviating, as I have frequently seen, the necessity of two separate incisions in cases of mistaken diagnosis.

It is self-evident that transverse incisions in the upper part of the abdomen should be of additional advantage, because all of the organs in the upper abdomen—namely, the free edge of the liver with the gall-bladder, the stomach, the entire transverse colon, and the pancreas—run parallel with the greatest length of the incision, and greater areas of these organs can be more readily exposed through such an incision.

Should drainage be necessary, the drain is allowed to emerge at any convenient point, and does not interfere with the subsequent closure of the wound. I may also mention here, that the subsequent scar is not weakened by the drainage, and that I have never seen a hernia to result.

Objection might be raised to the transverse incision by the fact that it is difficult to expose, through such an incision in the upper part of the abdomen, the viscera situated in the lower part of the abdomen and pelvis. In reply I can only say, that upon a number of occasions I have removed the appendix through such an incision; and that if a major operation is to be done upon the pelvic organs, usually a separate incision must be made no matter whether the first incision is vertical or transverse.

(3) *Ease of Execution, as Far as "Getting Out" is Concerned.*—

## TRANSVERSE INCISIONS IN THE UPPER ABDOMEN

I have conceded a slightly greater difficulty, and also a trifle longer time, in "getting into" the abdomen, in comparing the transverse with the vertical incision; the time so lost will, however, be made up during the operation *per se*, owing to the more perfect exposure; while during the closing of the wound there will actually be time gained. I make this statement with circumspection and yet definitely, because Sprengel, the originator of the method, contradicts himself somewhat regarding this point. On page 574 (*l. c.*) he makes the statement, that in difficult cases the suturing of a transverse incision takes twenty-five to thirty minutes; while on page 590 he states, that the much relaxed peritoneum, transversalis fascia, and posterior sheath of the rectus permit of an easy and rapid closure of the abdomen at the end of the operation. Even Kehr (*Archiv f. klinische Chirurgie*, vol. xcvii, p. 80), who, as is well known, is partial to his "Wellenschnitt" in all gall-bladder operations, and therefore condemns the transverse incision, praises the ease of closing the latter; he explicitly says that it was the only point about the incision which pleased him.

My method of closing the wound is the following:

Assuming that the incision does not extend beyond the limits of one rectus, a strong artery forceps first marks each angle of the incision. It has already been emphasized that the peritoneum is so intimately united with the overlying structures that no attempt is made to isolate it; the first suture line therefore includes not only the peritoneum, but also the transversalis fascia and the posterior sheath of the rectus, which, as is well known, is composed in this part of the abdomen of the blended aponeuroses of the transversalis muscle and posterior lamella of the aponeurosis of the internal oblique. As suture material I use either iodine catgut or, in very muscular individuals, chromicized catgut. The actual suturing proceeds easily and in a very leisurely manner up to the point at which the posterior sheath of the rectus joins the anterior; when this point of the suture line is reached the suture is tied (Fig. 10).

If the falciform or round ligament of the liver has been divided, it is now repaired by one or two sutures.

If more than one rectus has been divided, the remainder of the incision is now sutured in the manner outlined.

If drainage is used, the suture line is interrupted at the site of the drainage, and is finished on the other side of it in the usual manner.

The greatest saving of time is effected in this part of the operation. It actually must be seen, or better still, done, in order to be appreciated. I make this assertion not only on practical grounds, but also on theoretic-



cal grounds. In the previous pages I have already pointed out that a suture of a longitudinal incision is difficult on both anatomical and physiological grounds. If this statement is accepted to be true, and if the difficulty is really due only to certain definite anatomical reasons, then the converse must be also true, namely, that suturing of a transverse incision must be easy. This is really so for several reasons: First, because the suture line is not pulled asunder by the divided muscle, and, second, because the suture line approximates not a lot of little tendons, but acts as if it would tie together, as it were, a mass of little tendons.

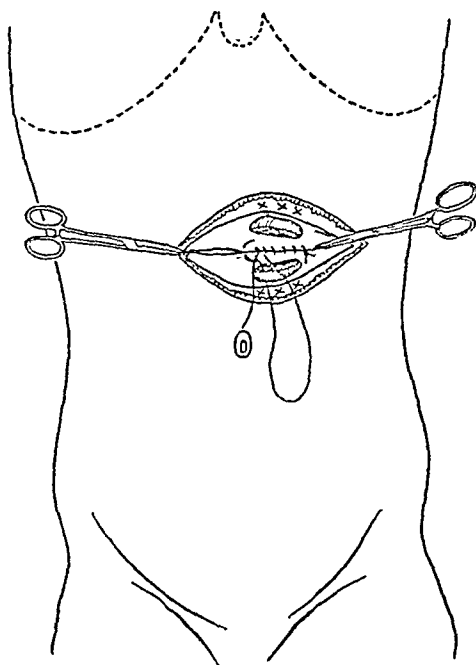


FIG. 10.—Suturing of the peritoneum and posterior sheath of the rectus.

All surgeons must be aware of the difficulties encountered in closing the peritoneum in a customary vertical incision; and after succeeding in finally closing it, how distressingly flimsy it is. Compare that with the playful ease with which the suturing of a transverse incision is done, and compare it with the evident firmness of this suture line, and I am confident even the most sceptical will be convinced. I am sure most surgeons must have experienced a dread of the entire suture line being torn open by the first straining efforts of the patient, but no such danger arises in a transverse wound, no matter how much the patient strains; on the contrary, the sutured edges only become tighter.

A couple of sutures are passed mattress fashion through each rectus and its anterior sheath (Fig. 11); these when tied approximate the cut

## TRANSVERSE INCISIONS IN THE UPPER ABDOMEN

edges of the fibres of the rectus, and obliterate what otherwise might be a dead space. The incision in the anterior sheath of the rectus is then closed by interrupted chromicized catgut sutures (Fig. 12).

It being impossible to make a layer suture of the linea alba after a transverse division, this structure is repaired in every instance by as many interrupted through-and-through stitches as are indicated; usually two or three suffice. Finally the skin is closed in the ordinary manner.

(4) *Post-operative Comfort*.—My experience with transverse incisions leads me to unhesitatingly state that, soon after operation, patients with transverse incisions are in every respect much more comfortable

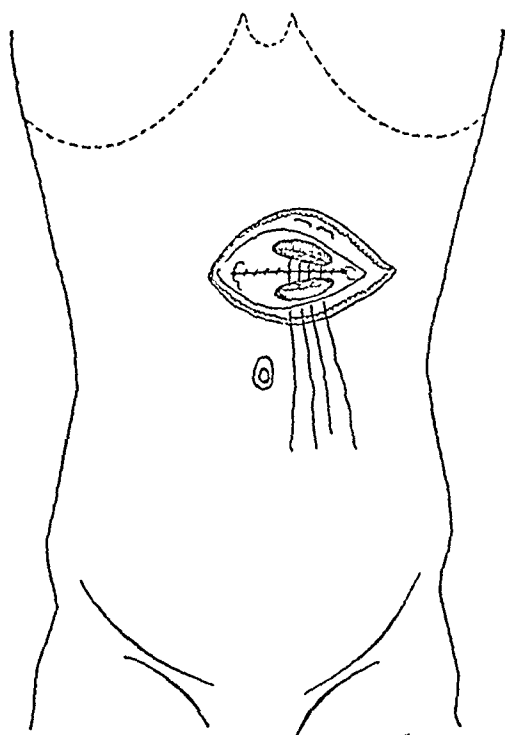


FIG. 11.—Mattress sutures to approximate the divided rectus.

than patients with vertical incisions. I have also noted that the vomiting is less in frequency and amount; but even if they vomit, it is associated with much less distress. There also appears to be much less pain in general, and particularly during all those functions which involve a strain upon the suture line, such as vomiting, sneezing, coughing, etc. It is self-evident why this must be so; in a vertical incision, during straining, the incision and suture line are pulled and torn apart, while in a transverse incision the opposite happens, namely, a relaxation of the parts.

I have also gained the impression that transverse incisions heal much more kindly than vertical incisions. I am at least certain, that a few

days after a major operation, such as pylorotomy, or excision of a gastric ulcer, or cholecystectomy, patients beg for food and for permission to leave the bed. I certainly have not seen such occurrences in a similar length of time in a vertical incision.

(5) *Cosmetic Results.*—The cicatrices resulting from a transverse incision remain as a fine line permanently, and show no tendency to broaden, like the best healed longitudinal cicatrices. This is not at all surprising, and is just what might be expected. A study of Langer's "split lines (*Spaltlinien*)," as illustrated in Kocher's *Operative Surgery*, not only invites a transverse incision in the upper part of the

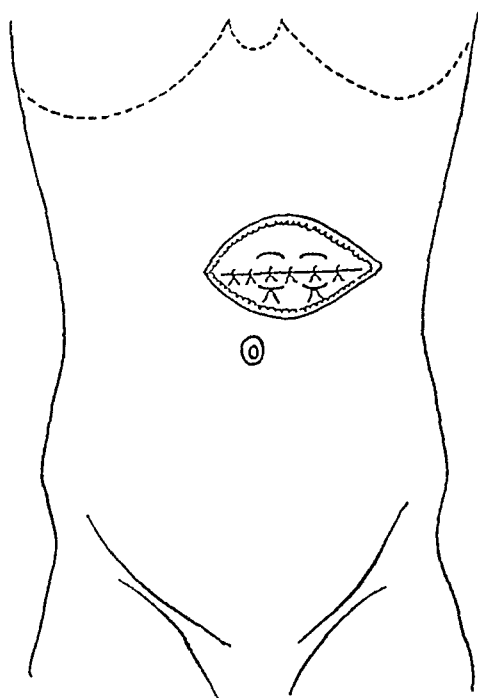


FIG. 12.—Suture of the anterior sheath of the rectus.

abdomen, but actually forbids a vertical one. I have watched these cicatrices very carefully, and I assure you I do not exaggerate when I state that most of them are hardly recognizable after a while, and must be searched for after the primary pinkness has faded away (Figs. 13, 14 and 15). This is practically analogous to the transverse incisions upon the neck, which, as is well known, give much finer and prettier scars than do longitudinal incisions. The site of drainage is drawn in slightly, but is not at all conspicuous or unsightly.

(6) *Late Results.*—The five requisites of a surgical incision of the abdomen which have been discussed thus far are all very important, they, however, play merely a secondary rôle, in comparison to the late

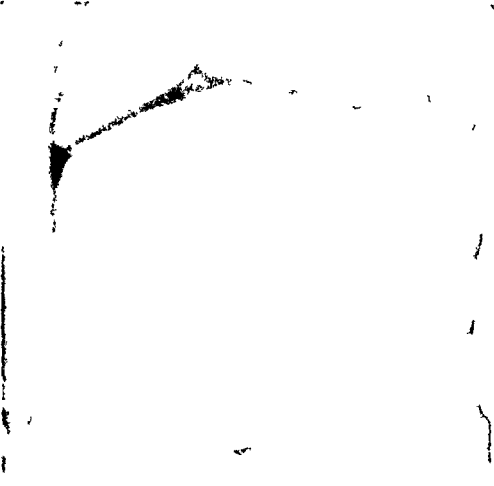


FIG. 13.—Cicatrix following transverse incision of the upper abdomen



FIG. 14 —Cicatrix following transverse incision of the upper abdomen.



FIG 15.—Cicatrix following transverse incision of the upper abdomen.



results; I refer particularly to the question of post-operative hernia. A perfect final result as far as post-operative hernia is concerned depends upon a number of factors. I do not intend to discuss these at length, but I may be permitted to refer briefly to some of them, as my experience has taught me that a number are influenced particularly advantageously by a transverse incision.

Surgical opinion is agreed that one of the most important factors in the prevention of post-operative hernia is a properly executed suture of the wound. I have already pointed out how difficult this part of the operation is in the customary vertical incision, and have also discussed the reasons for the difficulties. It is perfectly manifest, also, that such a poorly applied suture line is so flimsy at the termination of the operation, and so full of larger and smaller holes, as to permit of herniations or prolapses of the underlying omentum. If it does not do so immediately it does so very soon after the suture has been exposed to the first strain. If this manifestly inadequate suture line is compared with the very strong and firm suture line resulting from a sutured transverse incision, the superiority of the latter becomes absolutely evident.

It should furthermore be remembered that in the vertical incision the contractions of the lateral abdominal muscles have a strong tendency to pull the suture line further and further apart; while in the transverse incision the contractions of the lateral abdominal muscles not only have no such tendency, but, on the contrary, there is a strong tendency to approximate the edges. In other words, a particular advantage of this suture line lies in the fact that not only does it look beautiful at the moment of its application, but it, so to say, stays put subsequently also. It must be presumed, therefore, that such a perfect suture line must be an effective aid in the prevention of post-operative hernia.

Let us now examine a later stage of a transverse incision, which has healed by primary union, and has remained healed for some time. The peritoneal and aponeurotic incisions having been incised parallel with the course of the fibres, and having been sutured in the same direction, have doubtlessly united in an ideal manner. The only structure which was divided contrarily to correct surgical axioms is the rectus abdominis, and it is this part of the incision which requires careful scrutiny. I have frequently placed myself on record as denying the generally assumed important rôle of the muscles in the prevention of a hernia, and I ascribe this function only to the fascial and aponeurotic structures of the abdominal wall. Let us assume, however, for the sake of argument, that the rectus abdominis does share in this function; it is important, therefore, to inquire into the condition of the rectus

after its division and healing. I have had occasion to reoperate such patients only twice, and on both occasions I was surprised to find only a minimum amount of a very firm cicatrix in the substance of the rectus muscle; practically it was analogous only to an additional linea transversa. The nutrition of the muscle is apparently unimpaired, and, as its nerve supply has not been interfered with, its full function is also retained.

Bakes (*Archiv f. klinische Chirurgie*, vol. xcvi, p. 205), who was one of the first to put the Sprengel incision to a test, and who published his results in 275 cases, goes even so far as to say that in his experience it made no difference whether the rectus muscle was sutured or not; and even the cases in which no sutures were used to approximate the divided rectus healed ideally, and were not followed by a hernia.

It is conceded in general, that a most important factor in the production or prevention of a post-operative hernia is the amount and duration of drainage. In this connection I would therefore call attention to the fact that for a number of years it has been my custom to drain all cholecystectomies by a rather good-sized drainage tube, which is surrounded by strips of gauze, so that the final drain has a diameter of nearly one inch. It is also my custom to remove the gauze on the fourth or fifth day, while the tube drain is shortened gradually, and is not removed permanently until the tenth or twelfth day. In other words, my drainage is certainly bulky, and is certainly continued long enough. In spite of this fact, I have not seen a single case of post-operative hernia. The only difference to be seen between the drained and undrained cases is that there is a slight retraction, not a bulging, at the site of the drainage.

I know it is frequently stated that even a vertical incision is not followed by a hernia; but I also know that this statement is not warranted by experience. I have personally operated upon a number of herniæ following a gall-bladder and other operations through a vertical incision.

In this connection a short abstract of the history of the following case might be of some interest:

Gussie S., twenty-six years of age, was admitted to Mt. Sinai Hospital, November 4, 1912, with the diagnosis of intestinal obstruction. A more definite diagnosis could not be made; but the few existing physical signs led me to the belief that the seat of the obstruction was located in the upper part of the abdomen. At that time (November, 1912) I was not as yet convinced of the far-reaching possibilities of the transverse incision. I therefore first made a vertical incision through the upper part of the left rectus,

## TRANSVERSE INCISIONS IN THE UPPER ABDOMEN

very near the median line. I found a perfect example of that type of intestinal obstruction fully described by Payr, namely, dense adhesions between the left half of the transverse and upper half of the descending colon, with involvement of the splenic flexure; the descending colon was absolutely collapsed, while the proximal part of the transverse colon and the ascending colon were dilated. In order to obtain a better exposure, I added a transverse incision, so that the incision finally resembled an "L." The adhesions were separated, and when this was done the descending colon became distended with gas. Patient recovered. Primary union was obtained. I had an opportunity to examine this patient February 24, 1916, and found that the transverse cicatrix was solidly healed, but the vertical part of the incision had stretched, and was the seat of a ventral hernia.

After all, these arguments are only theoretical. The best, in fact I might say the only, way to judge of the late results of an abdominal incision is by examining patients after a considerable time. Fortunately, this has been possible in a fair percentage of my cases.

I find that I have operated 97 cases through a transverse incision, viz.: Cholecystitis (various forms), 36 cases; intrahepatic cholelithiasis with carcinoma, 1 case; abscess of the liver, 2 cases; gastric ulcer, 6 cases; perforated gastric ulcer, 2 cases; pyloric ulcer, 5 cases; duodenal ulcer, 13 cases; recurrent duodenal ulcer, 1 case; perforated duodenal ulcer, 1 case; carcinoma of the stomach, 11 cases; carcinoma of the stomach and pancreas, 2 cases; perigastric adhesions, 1 case; contraction of gastrojejunal stoma, 1 case; gastrocloptosis, 2 cases; pyloric stenosis, 2 cases; intestinal obstruction, pericolic adhesions, 1 case; carcinoma of pancreas, 1 case; carcinoma of transverse colon, 1 case; torsion of omentum, 1 case; chronic pancreatitis, 3 cases; multiple cysts of kidney, 1 case; undefined abdominal pain, 3 cases.

The following operations were carried out on these patients: Cholecystectomy, 31 cases; cholecystectomy and choledochotomy, 6 cases; cholecystostomy, 2 cases; choledochoduodenostomy, 1 case; incision and drainage of abscess of liver, 2 cases; gastrojejunostomy (posterior retrocolic), 29 cases; closure of perforated gastric ulcer and gastrojejunostomy, 2 cases; closure of perforated duodenal ulcer and gastrojejunostomy, 1 case; excision of gastric ulcer, 1 case; partial resection of stomach, 3 cases; pylorotomy, 1 case; Coffey-Beya operation, 2 cases; liberation of perigastric adhesions, 2 cases; liberation of pericolic adhesions, 1 case; extirpation of omentum, 1 case; colosigmoidostomy, 1 case; appendectomy, 3 cases; transperitoneal nephrectomy, 1 case; exploratory laparotomy, 7 cases.



Nine of these patients died during their stay in the hospital. Six patients died after their discharge from the hospital, at intervals varying from a few months to over a year. Three patients probably died, as they were afflicted with a fatal malady. Twelve patients could not be traced. Deducting all these there are available for examination 67 cases. I have personally examined every one of these cases at the time of writing this paper, and *did not find a single hernia*. The period of observation is from a few months to almost six years.

In discussing the question of post-operative hernia after transverse incisions, two of my cases are of special interest, because they prove two very important points: first, that a perfect result can be obtained even after relaparotomies, and, second, that an excellent result can be obtained even after very imperfect suturing, and in the presence of infection.

CASE I.—Rose B., forty-six years of age, was admitted to Mt. Sinai Hospital, December 23, 1912, with a history of repeated attacks of cholecystitis extending over a number of years. She was operated upon by me December 26, 1912; the operation was a cholecystectomy, and was done through a transverse incision through the right rectus. Patient was discharged with a well-healed cicatrix January 9, 1913.

Patient was readmitted January 27, 1913, and stated that for the past five days she had been again suffering from attacks of pain in the epigastrium, which were severe enough to require the administration of morphine.

The presence of a slight, but undoubted, subicteric tinge of the sclera complicated the clinical picture.

Patient was kept under observation for a few days, but finally the general condition deteriorated to such an extent that exploration was decided upon. February 6: Incision through the old scar. A constricted loop of small intestine was encountered adherent at the site of the previous operation; in liberating this loop it was damaged to such an extent that I found myself compelled to resect four inches, after which I made a side-to-side anastomosis. After considerable difficulty the common duct was isolated, incised and probed in both directions. No obstruction was found, but it was drained, nevertheless, by a T-tube. The wound was closed in layers.

The post-operative course was marred by a pneumonia and pleurisy. The biliary discharge continued for a very long time, and the fistula did not close finally until March 17. Even then the convalescence was very slow, and the patient was not discharged until April 12.

## TRANSVERSE INCISIONS IN THE UPPER ABDOMEN

I saw the patient January 15, 1916, or just three years after operation, and the result was ideal in every respect; scar was absolutely firm.

CASE II.—Morris T., forty-one years old, was admitted to my service at Mt. Sinai Hospital, November 19, 1914, with a history of an ulcer of the stomach of fourteen years' duration. Patient was operated upon through a transverse incision through both recti, on November 25. The operation consisted of an excision of an ulcer of the stomach situated upon the posterior wall near the cardia. The subsequent closure of the defect of the stomach was exceedingly difficult. The post-operative course was very stormy, as the patient vomited continuously and required very frequently repeated lavage. This put such a strain on the sutured abdominal incision that I was not at all surprised to find, on December 3, that about four inches of it had separated; I therefore resutured it, without any anæsthetic.

On December 5 the persistent vomiting and inability to retain any nourishment compelled me to reopen the abdomen through the original incision for the third time, for an intestinal obstruction, due to a band. The operation lasted but a very short time, as all that was necessary was to divide a band; patient, however, went into a deep collapse. In order to obviate a death upon the operating table, I hurriedly closed the wound with five through-and-through silk sutures.

To my surprise and gratification this patient also recovered, and was finally discharged January 9, 1915. The wound, although infected and only very inadequately sutured, healed with a perfect scar; and in spite of these disadvantages no trace of a hernia was to be seen at my last examination, March 26, 1916.

Bakes (*l. c.*) re-examined 67 of his cases operated through a transverse incision and has not found a single hernia. Bakes's period of observation is much too short for a final judgment, and I hope that perhaps my small statistics will aid in elucidating this point.

# THE TECHNIC AND THE MANAGEMENT OF OPERATIONS ON THE STOMACH\*

BY GEORGE W. CRILE, M.D.  
OF CLEVELAND, OHIO

ALTHOUGH surgery of the stomach has attracted to its problems the most gifted men of their day—from Billroth to Mayo; although every trick of technic, every plan of management suggested by intense study and large opportunity has been employed, yet the mortality rate in major cases remains high.

If there is to be improvement over the results already secured, it is obvious that it will not be from improved judgment, nor from greater experience or more skilled technic, but that improvement will come through the application of some other factor. It is only by extending our vision so as to comprehend more completely the patient *as a whole*, as well as the local lesion, that progress will be made.

If we bear in mind that life is possible only in an alkaline medium; that the sources of the alkalinity of the body are food and water, and that the mere expression of life—the maintenance of body heat, the production of muscular action and emotion, and the injury of body tissues—produces acid by-products, then it is readily seen that in a patient whose food intake has been reduced to a minimum by pyloric obstruction, the ability of the body to maintain its alkalinity will be correspondingly diminished and the patient will easily be pushed beyond this low margin of safety by the acid-producing factors of the operation.

It becomes obvious, therefore, that in these cases we must aim to increase the reserve alkalinity, and to diminish or control the production of acids in the operation itself.

*First*, the reserve alkalinity may be increased by administering approximately 2000 c.c. of normal saline solution subcutaneously the afternoon and evening before and on the morning of the operation; and giving approximately 100 grains of sodium bicarbonate by mouth or by rectum. Perhaps the most important pre-operative procedure is a night of natural or artificial sleep, since the real lesions produced by acidity are repaired only during sleep.

*Second*, the acid-producing factors connected with the operation are worry, exertion, inhalation anæsthesia, the cutting and handling of

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\* Read before the American Surgical Association, May 11, 1916.

unanaesthetized tissue, and post-operative pain. Fear and worry are largely in the control of the surgeon and nurses. In bad risks the indications are for nitrous oxide analgesia; anæsthesia only during the period of manipulation; local anæsthesia throughout; feather-edge dissection; minimum handling; quinine and urea infiltration of the abdominal wall; opium to control post-operative pain; normal saline solution subcutaneously until food is taken; and a five per cent. solution each of sodium bicarbonate and glucose by the Murphy drip. The patient should be propped up in bed early; put on his feet early; and should be in condition to go home early.

In doubtful cases, if resection is to be done, the operation, as Lilienthal has suggested, should be performed in two stages; the first a gastrojejunostomy; followed by the resection in about a week or ten days. At the end of this interval the nutritional balance will have been immensely improved, the reserve alkalinity will have increased, and the morale of the patient will be improved.

As Mayo has indicated, an ample incision is made and, as in all associated operations, the skin incision and every division of nerve-bearing tissue is preceded by the injection of novocaine; and immediately after opening the abdomen a massive infiltration with quinine and urea hydrochloride is made at a distance from the line of incision. As to the length of the loop of jejunum, we are satisfied that no absolute rule should prevail except that it should be long enough to lie comfortably and easily. This is as much a matter of mechanical adjustment as is the work of an engineer or a joiner. So, likewise, the direction in which the jejunum shall be turned depends upon the position of the gastrojejunostomy opening in the stomach. If the opening in the stomach is far to the left of Treitz's ligament, so that the pull will be toward the left, then the jejunum should take its course to the left. It is better to make the stoma in the stomach as near the pylorus as is mechanically feasible. In the large majority of cases, therefore, the anastomosis falls to the right of Treitz's ligament, in which case the jejunum is carried from the left to the right.

As to the position and direction of the opening in the stomach, obviously, as has been well brought out by Hartman, it should be near the pylorus, and we are satisfied that it is best to make the incision in the stomach along the middle zone, where there are fewer blood-vessels, and parallel to the long axis, as thus the stomach will lie comfortably along the long axis of the jejunum. I cannot conceive that the traction of the jejunum to the left or right, or the position of the stoma in the stomach, whether vertical, transverse or longitudinal, can have any

influence whatsoever upon the passage of the food out of the stomach or on the propulsion of the food after it has reached the intestine. The *opening* has no propelling power, that power lies in the mechanism of the stomach and the jejunum respectively. The opening in the mesocolon is best made by sharp knife dissection rather than by a blunt perforation or by a tear made by traction, as thus more definitive and purposeful control of the opening is possible. We suture the mesocolon opening an inch up on the stomach wall so that this portion of the stomach goes down through the mesocolon like a hopper and the freedom of the ends of the jejunum is unhampered. We believe that this is preferable to suturing the mesocolon opening upon the line of suture at the stoma between the stomach and the intestines, as in this position it may produce kinking at the point of junction between the ileum and the stomach.

As to the first line suturing, we agree with Mayo, that silk and linen should be avoided. We use chromic gut for the sutures that come in contact with the mucosa. For the peritoneal layer we use interrupted silk sutures made as Cushing right-angled stitches. These stitches include the muscular coat and are so placed as to be equivalent to a continuous suture. At the point where the stomach and jejunum are approximated we put in two or three carefully placed interrupted sutures, so that the duodenum is brought in contact with the stomach wall on each side of the incision for a distance of from a half to one inch.

The main suture which controls absolutely both hemorrhage and leakage is made with the shoemaker stitch, the introduction of which is facilitated greatly by the Bartlett needle and suture. The shoemaker stitch includes the entire structure and strength of the wall of the stomach and intestine.

*The Resection.*—In most cases it will be found that the gastrojejunostomy and the interval of adjustment have accomplished for these patients what the delay of a week accomplishes for fractures of the patella; what iodoform gauze packing accomplishes in the first stage of a laryngectomy; what acute salpingitis does for later salpingectomy. In each instance the protective reserves against infection are called out into the local field and adequate local defense against infection in the later operation is thus guaranteed. Usually very few fragile adhesions will be found and the entire operative field will be easily mobilized. The gastrojejunostomy will appear as if it were a natural opening. In most instances no pull or strain will be necessary to develop the field, and the gastrojejunostomy will not interfere with the elevation of the stomach for the resection. The stomach is carefully divided with a cautery between Payr's clamps, and the margins of the division are sterilized

with the cautery. The searing should be done so slowly that not a drop of blood will appear on the surface. But another and most vital purpose is achieved by this cauterization. One of the commonest dangers in operations for cancer anywhere is that of cancer implantation on the fresh tissues. The searing makes a dry charred surface which cannot sustain cancer growth. Therefore the cautery sterilizes against pyogenic infections and against cancer growth and prevents bleeding—three of the most important considerations in gastric resection. As in the gastro-enterostomy, protection against leakage or hemorrhage is secured by the shoemaker stitch, and to make assurance doubly sure a special invaginating silk stitch is put around each angle with a final separate layer of right-angle silk stitches. The duodenal end is inverted by a purse-string suture.

*Clinical Results.*—The total number of operations on the stomach by my associates, Drs. Bunts and Lower, and myself and in the Lakeside surgical records are 468. Comparing our previous results with those since the foregoing principles have governed us, Dr. Lower and I have performed, up to May 1, 127 operations. In this series there have been two deaths.

## MORE RADICAL TREATMENT OF DUODENAL AND GASTRIC ULCER\*

BY JOHN B. DEEVER, M.D.

OF PHILADELPHIA, PA.

It is now known that duodenal ulcer is more frequent than gastric ulcer. Duodenal ulcer is most often located upon the anterior and lateral wall of the first portion of the duodenum. The next most common site is the posterior wall of this portion of the intestine, and the least common site the inner pancreatic wall of the second portion of the duodenum.

Where the ulcer is small and is located upon the anterior wall of the first portion of the duodenum it is my practice to excise it, close the opening in the intestine, plicate the duodenum and make a posterior gastro-enterostomy. When an ulcer in this portion of the intestine is large, but extending short of the head of the pancreas, I amputate the duodenum below the lesion, purse-string it, invert, excise the pylorus, and make a posterior gastro-enterostomy. When the ulcer is on the posterior wall of the first portion of the duodenum and not too adherent to the posterior abdominal wall to permit of freeing the duodenum, I practise the same technic as in large ulcers upon the anterior wall.

When the amputation of the duodenum is made so close to the head of the pancreas as to preclude the use of the purse-string suture and inversion, I adopt one of two procedures; namely: (1) dissect the inner wall of the duodenum free from the pancreas (taking care not to injure the common bile-duct), purse-string it, invert and reinforce line of duodenal stump with great omentum, or (2), if this cannot be safely done, close the end of the duodenum with a continuous chromic catgut stitch and sew the head of the pancreas over the duodenal stump. This I have done in many cases with good results up to the present, except in one instance. The chief point for discussion in the latter technic is the effect that the pancreatic ferments may have upon the transplanted duodenal stump, or, *per contra*, the possibility that the infection from the duodenal stump may be communicated to the pancreas.

In acute perforation of a duodenal ulcer it is my practice to make a posterior gastro-enterostomy at the primary operation. I have now

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\* Read before the American Surgical Association, May 10, 1916.

operated upon 44 patients in this manner with but one death. My reasons for advocating this procedure are, first, in order to place the ulcerated area immediately at rest; second, to secure the ultimate advantage of the operation, which is curative in many cases, and, third, because my experience with it has been so satisfactory as to entirely outweigh any theoretical objections that may be made against it.

The most common site of ulcer of the stomach is at the pylorus and the most common form of ulcer the chronic indurated. Next in frequency of location is the lesser curvature, the posterior wall, the anterior wall, the margin of the œsophageal opening and the fundus.

The chronic indurated ulcer of the pylorus I always treat by making a pylorectomy. When the induration of such ulcer involves the lesser curvature in proximity to the pylorus, I make a subtotal gastrectomy.

Small ulcers of the lesser curvature, with but little induration, are better dealt with by excision—first open the lesser peritoneal cavity by breaking through the superior layer of the gastrohepatic omentum and ligate the arteries to either side of the ulcer, then excise the ulcer, close the opening in the stomach by oversewing the mucous membrane with a continuous chromic catgut suture and with the same suture oversewing the remaining coats, completing the closure with a continuous Lembert (Dupuytren) catgut or linen suture.

When the ulcer is on the lesser curvature and the induration involves to a considerable extent the anterior and posterior walls of the stomach, it is my practice usually to make a circular resection with end-to-end union. In the latter type of ulcer if the condition has involved so much of the anterior and posterior walls of the stomach as to cause the hour-glass stomach, I make a circular resection in some cases, while in others I make a gastrogastrostomy between the pouches and a posterior gastro-enterostomy with the lower pouch. When the ulcer is located on the posterior wall, excision through the interior of the stomach is the operation of choice. In the latter operation, having excised the ulcer and closed the stomach, in order to insure against any possible chance of leakage, I open the lesser peritoneal cavity by going through the anterior layer of the gastrocolic omentum, expose the posterior wall of the stomach at the site of the sutured ulcer and reinforce the line of suture with a continuous Lembert (Dupuytren) suture, afterwards closing the opening in the gastrocolic omentum.

Any ulcer that has not gone deep enough into the mucosa to cause hemorrhage, that has not obstructed the pylorus, or remained chronic long enough to be indurated, can only be demonstrated with certainty by opening the viscus to inspection; this I have done a number of times.



This type of ulcer should be treated by operation. Gentle palpation of the stomach may detect such an ulcer, yet as a rule an ulcer in this stage can only be located by incision and inspection.

CASE I.—Female, aged fifty years, married. Chief complaint, feeling of pressure in epigastrium. Two years ago began with a feeling of pressure and fulness in the epigastrium, at which time her feet commenced to swell and remained swollen for a week. Always has considerable gas; eructates freely; frequent vomiting; vomiting not preceded by nausea and occurs independent of taking of food. Never jaundiced, never any very severe pain. Bowels constipated. Has lost 17 pounds in the last year. During this time has been under medical treatment without any result.

*Previous Medical History.*—Ordinary diseases of childhood. Nervous breakdown two years ago, when was operated for laceration of cervix; peritonitis following operation.

Urine: Specific gravity, 1080, faint trace of albumin, otherwise normal.

Test-meal: Free hydrochloric acid 50; total acidity 70; occult blood faintly positive to benzdine; negative to guaiac.

Full meal: Removed in eight hours; 60 c.c. recovered; free hydrochloric acid 18; total acid 38; occult blood positive to benzdine; negative to guaiac.

*Operation.*—Abdomen opened; small hardened area, size No. 6 shot, felt in the lesser curvature of the stomach. This had been demonstrated by X-ray examination as an ulcer by Dr. Cole of New York City. Gastrotomy—when the hardened area was found to be due to a small ulcer which had involved the mucous and muscular coats. Ulcer excised.

Culture of interior of stomach taken at time of operation, sterile.

In my opinion, as well as in the opinion of others, posterior gastro-enterostomy does the greatest good when the pylorus is obstructed. In ulcers located other than at the pylorus, this operation does but little if any good; and, if any, only by allowing enough bile and pancreatic juice to enter the stomach, thus producing a neutralizing effect upon the hydrochloric acid. That this operation accomplishes any good by drainage alone, I think is doubtful. To repeat, where this operation accomplishes most good is when there is pyloric obstruction and when the ulcer has been excised.

I have, however, seen good results from a posterior gastro-enterostomy with occlusion of the pylorus in multiple erosions (Dieulafoy ulcer) of the stomach causing repeated bleedings. It is not my practice

to advise operation in these cases until medical treatment has been tried or a focus of infection, such as a diseased appendix or gall-bladder for example, has been removed.

When excision of the ulcer has not materially interfered with the mechanics of the stomach, with the exception of the pyloric ulcer, posterior gastro-enterostomy should not be done. I never make a posterior gastro-enterostomy in central resection of the stomach, for example.

Ulcers of the margin of the oesophageal opening and of the fundus of the stomach, if we are fortunate enough to see them very early, before there is much induration, could be excised. Ulcers in these locations I admit are rare, but that we occasionally meet with them in an advanced stage we must concede. I have seen a few cases of carcinoma in these locations which I believe were implanted on ulcer.

To summarize, I have come to the conclusion that all ulcers of the duodenum or stomach are best treated by excision.

In the presence of a strong clinical probability of gastric ulcer supported by positive X-ray evidence or doubtful findings to palpation and inspection I do not hesitate to perform gastrotomy in order to settle the matter by inspection of the mucosa.

In the individual case the advisability of excision depends upon the local condition. No ulcer should be excised when subsequent closure and anastomosis present too great operative hazards. It is in such cases that operations which depend upon drainage and alteration of gastric chemistry have their field.

# RADIUM TREATMENT OF UTERINE CANCERS\*

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AND

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THE mortality of radical removal of the uterus for cancer, that of the body excepted, is so high and the end result so gloomy that we would all welcome a method of overcoming the disease, if without instituting a hazardous operation it would offer at least an equally good end-result. Whether radium treatment can do this, the next few years must determine.

Whatever else may be said of it, it does not immediately jeopardize life; it at least is safe. The discovery of the unique qualities of the ultra-penetrating gamma rays by Dominici marked an epoch in radium therapy. His principle of filtration permits the use of large quantities of radium without destructive effects on healthy tissues. It also permits the deep action of the rays without interfering with the viability of superficial tissues covering deep-seated lesions.

While it is not within the scope of this paper to discuss the scientific principles of radium therapy, a few words may not be out of place.

Numerous microscopic observations have shown that radium has a definite selective action on neoplastic tissue. For instance, a cancer of the uterus treated by radium shows definite histologic changes. During the first two weeks there is increase in size and vacuolization of the nuclei and numerous atypical mitoses are found. This is followed by change in form, enlargement, and vacuolization of the cancer cells; retardation and finally cessation of nuclear division. The last stage is the destruction of the cell. This is accompanied by infiltration of leucocytes, the formation of new connective-tissue cells, and gradual replacement of neoplasm by fibrous tissue. There is always an obliteration of the blood-vessels, probably due to a proliferation of the intima. This in itself tends to the destruction of the highly organized neoplastic cells by interference with nutrition. It is one of the most potent factors in the radium cure of uterine fibroids. The metamorphosis of the cancer cells is always interesting, and at times unusual. Occasionally one may see in typical cancers of the cervix a tendency to cornification. In clinically cured cases of uterine cancer there are at times seen nests of

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\* Read before the American Surgical Association, May 10, 1916.

## RADIUM TREATMENT OF UTERINE CANCERS

changed, but undestroyed, cancer cells, imbedded in dense fibrous tissue. Whether or not these cells are capable of further growth and dissemination has not as yet been determined.

Whether the action of radium on neoplastic tissue is specific, or whether it is due to the great cell richness of the latter is merely an academic question. All things being equal, the action of radium on any tissue is in proportion to the abundance of nuclei. This has been well shown by Keetman and Harting,<sup>1</sup> who have shown that radium depends for its action on the denser substances in the nuclei of the cells. For this reason, the more closely the tissue approaches the embryonal type, the more amenable it will be to the radium treatment. This accounts for the remarkable results achieved in the treatment of lymphosarcoma. Also, the comparative obstinacy of periosteal and chondrosarcoma to radium action.

The uterus presents an unusually fertile field for radium therapy, partly from the histologic structure of uterine cancer, but particularly because of its unusual accessibility. The radium can be brought into immediate contact with the neoplastic tissue where it can exert its direct influence. The primary results of radium therapy in this field have even exceeded the hopes of a few years ago. The reports grow more and more encouraging.

According to the report of the London Radium Institute, of 1914, uterine cancers yield most gratifying results, and the effect of radium in operable cancers is far in advance of those obtained by any known surgical or medical treatment.

Degrais<sup>2</sup> has a number of cases apparently well after four and five years, Rubens Duval,<sup>3</sup> in a report of five years' experience, recounts a most interesting case of inoperable cancer of the uterus, which died of some intercurrent affection several years after radium therapy. Autopsy showed a complete anatomical cure. Of 158 cases reported, radium had a beneficial action in 155. In 93 the improvement was classed as phenomenal, while in 46 there was a probable cure.

Degrais and Belot have seen no case of cancer of the uterus in which some benefit has not been given by radium therapy. The question of the entire replacement of radical operation by radium therapy may soon come up for final solution.

The mortality of the Wertheim operation is from 15 to 25 per cent. in the hands of the best operators, and far greater in those of the average surgeon, and the percentage of cases which are in condition to undergo this operation is not very large. Probably the greater number of those who undergo the Wertheim operation suffer from recurrence

within the first year after operation. Many operators have taken the mid-ground in the treatment of operable cancers of the uterus. For instance, Pozzi<sup>5</sup> has given up the extensive Wertheim operation even in border-line cases, and treats them with radium alone. In operable cases, a simple vaginal hysterectomy is done, followed by prophylactic radium application.

The consensus of opinion of all operators is that operation after radium therapy is exceedingly difficult. For instance, Kelly<sup>4</sup> says in the conclusion of his article, "in border-line and inoperable cases we advise the use of radium, as operative measures are impossible in this group. If the growth disappears, it can only be determined whether or not hysterectomy is advisable by trying out both methods. This as yet has not been done in a sufficient number of cases to arrive at any definite conclusion. We do feel, however, that when clinical cures have occurred in operable cases, operations are probably best not carried out."

In a personal communication Kelly stated that inoperable and border-line cases clinically cured by radium should *not* be subjected to operation.

The reason for the difficulty of operation in cases after radiation is easily understood from the fact that there is a great deal of fibrous tissue deposited which makes clean dissection extremely difficult and dangerous.

We have recently seen a striking example of this diction. In September, 1915, we saw a woman, aged forty-three. Five years before, a supravaginal hysterectomy had been done for fibroid. In June, 1915, she began to pass clots of blood. There was a great deal of backache. Examination shows cervix fixed and occupied by hard cancerous nodules. There was a marked infiltration of the left broad ligament. Under radium treatment the mass melted away, the bleeding stopped, and the pains disappeared. In March, 1916, against our advice, a vaginal removal of the cervical stump was attempted. The operation was exceedingly difficult and incomplete. The specimen removed showed a great deal of fibrous tissue and some few nests of embedded cancer cells. From the time of the operation the pains recurred and the wound did not heal. Manifestly, as we have stated before, anything like a complete operation is impossible after extensive radium treatment. Whether this case would have remained permanently well is doubtful. Her condition, however, was certainly only made worse by operation.

The results of Kroenig and Doederlein<sup>6</sup> are only too well known to require more than mention.

The immediate local results of radium are phenomenal. Within a

## RADIUM TREATMENT OF UTERINE CANCERS

week of the first application the hemorrhage is, as a rule, arrested and the foul discharge stopped. We have not had a case in which we were not enabled to arrest both the offensive discharge and the hemorrhage within from one to three weeks. The cauliflower vegetations which frequently fill the vagina seem to melt away. The improvement of the general condition of the patient is astounding. Pain is sometimes relieved within a few days of the first application. The most difficult cases in which to effect a benefit are those which recur after a Wertheim operation. The fibrous tissue scars are so dense as to seem almost impervious to radiation. However, even these cases can be benefited, but we have no cure lasting more than a year. The pain in these cases is more difficult to relieve than in those that are primary. The tissues are dry and densely infiltrated with scar tissue.

Out of 25 cases treated in this series, 11 are still well. Of these 3 have been well for two years, 6 from one to two years, and 2 from six months to a year. Of the 11 clinical recoveries, there were 3 operable and 8 inoperable. Of the 3 operable cases one is well after two years, and 2 over one year. Though the cases are few, this is in itself an interesting observation, as a recurrence after operation usually occurs within the first six months.

A few of the results obtained seem to warrant individual report.

CASE I.—Mrs. S., aged forty-five, was brought to the Jewish Hospital in an ambulance, in what seemed to be the last stage of a secondary anæmia. Red count 2,400,000, marked poëcilocytosis, hæmoglobin 40 per cent., weight 72 pounds. The vagina was completely blocked by exuberant masses springing from the cervix. There was, however, no involvement of the vesicovaginal or rectovaginal septum. March 15, 1915, contrary to our usual custom, in order to more promptly control the hemorrhage, the mass was curetted away, and cauterized with the actual cautery. One hundred milligrammes of radium were buried in the crater. On March 20, the hemorrhage was entirely stopped. Radium treatment was repeated four times between that and May 17. After the last treatment there was some rectal irritation. She was sent home and told to return for treatment in about two months. Nothing more was heard from her until April, of this year, when in answer to inquiry she stated she was in excellent health, weighed 110 pounds, normal weight 125, and that she did her own housework. Aside from a slight rectal irritation she was in excellent health. She has been perfectly well for over a year.

In all of the cases classed as inoperable, the uterus was firmly fixed in the pelvis, and there was marked hemorrhage and more or less putrid

discharge. In all of these cases one of the most noticeable phenomena was the increased mobility of the uterus after the first few treatments. After more extensive radiation, the uterus again becomes more or less fixed by the new-formed fibrous tissue.

In one case we have had a recovery after a comparative incomplete series of treatment.

CASE II.—Mrs. H., aged seventy-one, seen first May 1, 1915. Has had slight hemorrhage from the uterus for a year and a half. For the past seven months very severe. Examination shows a carcinomatous degeneration of the entire cervix, with complete fixation of the uterus. Four treatments were given in all, and at the end of that time the cervix was normal and uterus movable. The patient refused further treatment. She is still well, although more than a year has passed since the last treatment.

In our experience there has been no single case in which the radium treatment was not followed by some benefit. One of our earliest cases came into the hospital in what seemed the last stages of septic infection. The vagina was filled with great masses of carcinomatous tissue, and the odor of the discharge was terrifying. After three radium applications of 24 hours each, the discharge stopped, the foul odor disappeared and the patient began to gain in weight. She died five months later of a large perinephric abscess, but there was no return of the vaginal involvement.

Cases approaching this in severity are numerous in our series, and show that practically no case is too far advanced to be at least temporarily helped by radium treatment. In cases where there is involvement of the recto- and vesicovaginal septa great care must be exercised because of the danger of fistula formation.

Parenthetically we may here allude to an unpleasant sequel of radium therapy which we have seen in a few of our clinically cured cases. It is a pain in the rectum which occasionally becomes quite severe. It probably results from scar tissue, but this, it must candidly be said, is only a surmise.

There are, of course, many methods of applying radium to cancers of the uterus, according to the contour of the growth. We vary our methods, using for this purpose either a disc-like brass filter or one cylindrical in shape. The former is reserved for cases in which there is a broad ulcerating surface, and the latter for those in which there is a disposition to crater form.

# RADIUM TREATMENT OF UTERINE CANCERS

## SUMMARY

1. Radium is the method of choice in the treatment of inoperable and border-line cases.
2. Of the three operable cases treated with radium a clinical cure has been effected in each case.
3. Cases clinically cured by radium should not be subjected to hysterectomy, as the operation is difficult and dangerous.

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# THE RADICAL OPERATION FOR CANCER OF THE RECTUM AND RECTOSIGMOID \*

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It is my purpose in this communication to discuss briefly five problems connected with cancer of the rectum and rectosigmoid: First, operability; second, operative mortality; third, operative disability; fourth, function following operation; and fifth, permanent cure. The discussion is based on a study of 753 patients whose histories were recorded in our clinic between January 1, 1893, and December 31, 1915. Of these 430 were subjected to radical operation.

*Operability.*—From January 1, 1910, to December 31, 1915, 619 patients with cancer of the rectum and rectosigmoid presented themselves for examination. A radical operation was performed on 312. In 186, the disease was so far advanced that operation was not advised; in 32, operation, though advised, for various reasons was not performed; in 89, on abdominal exploration the condition was found inoperable and the operation was terminated either as an exploration or as a palliative colostomy. Eliminating the 32 cases in which operation was advised but not performed, we have 275 belonging to the group in which a radical operation was not thought possible, against 312 in which radical operation was performed, an operability of 53.1 per cent. It is interesting to note in this connection that Harrison Cripps found it advisable to perform the radical operation on only 107 of 445 patients, an operability of less than 25 per cent.

In the three years just passed—1913, 1914 and 1915—277 patients with cancer of the rectum and rectosigmoid were examined and 199 were subjected to radical operation, an operability of 71.8 per cent., the increase being due to the fact that we did not refuse radical operation because of the local extent of the disease unless it involved structures which made its eradication impossible. In 6 cases a total hysterectomy was performed coincidentally because of extension of the disease to the uterus. The posterior wall of the vagina was removed in 12 cases. In 6, a part of the posterior wall of the bladder was resected. The whole or a part of the prostate and one or both seminal vesicles were

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## CANCER OF THE RECTUM AND RECTOSIGMOID

removed in 11. In two instances, the pelvic portion of one ureter being involved, the diseased portion was resected and the ends of the cut ureter were tied with catgut, without causing marked symptoms from the complete obstruction of the ureter. In another patient the greater part of the membranous urethra, the prostate, both seminal vesicles and the posterior half of the neck of the bladder were involved; these were removed. The patient lived nearly three years in good health before dying of metastasis. In 5 cases one or more loops of small intestine were resected because of direct extension from rectosigmoid cancer.

Ill-advised operations added very largely to the mortality, and in many instances, had it been possible to know in advance the extent of the disease, we would not have operated. It is a fact, however, that many patients with advanced disease not only recovered from the operation but remained well, and those who survived the operation and died later of recurrence received greater palliation and longer lease of life than would have followed colostomy.

Cancer of the rectum is not prone to early lymphatic involvement, tending to remain a localized process until late. In no case was lymphatic extension alone the cause of inoperability. Some patients in whom the rectal glands were involved have recovered and remained well following the radical operation, but none of our patients in whom the inguinal glands were involved made a permanent recovery, even after the most extensive glandular excision. The most frequent cause of inoperability was local extension of the disease to neighboring organs; the next in frequency was metastasis of the liver; and the third, peritoneal and retroperitoneal metastases.

Theoretically at least, the abdominal cavity should be explored in every case of carcinoma of the rectum because of the frequency with which metastases in the liver or peritoneal cavity are to be found, and unless such an exploration be made before a radical operation is undertaken, a number of patients will be subjected to a serious and mutilating operation without the possibility of cure.

Cancers which involve the upper rectum cannot be separated surgically from cancers of the terminal sigmoid. There seems to be a marked tendency for high cancer of the rectum to invade the sigmoid and those in the sigmoid to extend into the rectum proper. Hence it may be impossible to determine whether a given growth was primary in the terminal sigmoid or in the upper rectum. It seemed wise, therefore, to classify high rectal and terminal sigmoid cancers in one group as rectosigmoid cancers. In this group the question of operability is most difficult to decide.

*Operative Mortality.*—The mortality of the operation itself depends, to a large extent, on what cases are accepted for radical operation and how radical an operation is performed. For example, we performed 30 radical operations by the Harrison Cripps method without a death, but the number of cases in which this operation may be applied is limited if the patients' best interests are considered. Cases which, in our early experience, we would not have considered operable, we now subject to operation for reasons already given. Again, an operation considered sufficient in the first period was not considered sufficiently radical at the later period. Of the 753 cases, a radical operation was performed in 430, with an operative mortality of 15.5 per cent. During the period from 1893 to 1910 the operative mortality was 17.8 per cent.; from 1910 to 1913 it was 17.7 per cent. with an operability of 51 per cent.

For the years 1913, 1914, and 1915, the mortality averaged 12.5 per cent., and the operability 71.8 per cent., while the operations were made more radical. Increased experience has now brought this mortality to about 10 per cent., and a wiser selection of cases for operation will still further reduce the death-rate.

Comparison of the mortality in cancer of the rectum of various clinics shows that low mortality is coincident with low operability. An operability of 25 per cent. in our clinic would have reduced the mortality to a point under 5 per cent., since it would have eliminated cases with advanced disease which give the high mortality. It is a question of an advancing frontier in which large operability gives an apparently high mortality and a low percentage of cures, with the paradox that when the total number of cases is taken into consideration it will be found that a larger number of patients have been cured. In other words, operative mortality means nothing unless the total number of cases examined is taken into consideration.

All patients dying in the hospital after the radical operation were classified, without regard to the length of time that elapsed before death occurred, as having died from operation. Many of these patients died after some weeks from nephritis, cardiovascular disease, etc., which they had at the time of the operation. However, there seems to be no way of properly estimating mortality without including them, and a certain amount of statistical hardship must be accepted in order that we may have a common basis for computation. Consent is obtained for necropsies on about 95 per cent. of the patients who die in the Clinic. In cases operated on, we make it a rule that the operating surgeon or one of the surgical assistants shall attend the necropsy in order that his exact

technical knowledge of the operative procedure may aid the pathologist in arriving at the primary and contributory causes of death.

Among the facts which were especially apt to increase the mortality was obesity, the fat patient, especially the male, giving almost a prohibitive mortality from the one-stage combined abdomino-posterior operation. However, obese patients withstood well the two-stage operation and also operations of the perineal or posterior Kraske type, though in the case of very obese individuals the colostomy itself was sometimes made with difficulty and was attended by a very considerable risk. In such patients we have not infrequently made the posterior radical operation in a single stage, without exploration or colostomy, completing the operation with a posterior anus at or near the normal situation.

The important causes of operative mortality are:

1. Sepsis, 39.8 per cent. The sepsis was due usually to soiling the wound or peritoneal cavity during the operation with intestinal contents. This occurred most frequently in cases in which the growths had caused obstruction; consequently, radical operations are seldom permissible until the obstruction has been relieved. In cases of this kind the two-stage operation proved of the greatest value. The colostomy relieved the obstruction and made possible thorough cleansing of the lower fragment, which, by reducing the infection, tended to produce more favorable conditions for operation later. The disadvantage of this method lay in the fact that the blind stump created between the colostomy and the point where the lower sigmoid was turned in behind had a tendency to develop late infections, fistulas, etc., in the posterior wound. It would appear that the percentage of deaths from sepsis was too high and undoubtedly this is true. Few of the patients in whom the growth was movable died from sepsis following operation, but we found it exceedingly difficult to prevent soiling of the wound in those cases in which the rectum was fixed and the growth had completely penetrated through the walls of the rectum, especially when this fixation took place in a situation where the peritoneal cavity was involved. This was particularly true of the rectosigmoid cases in which the operation was necessarily performed from above—cases often complicated with abscesses in the pelvis and adhesions to the small intestines. In this group the mortality was more than 30 per cent. One might well ask: Is it justifiable to attempt the radical operation under these circumstances? The answer depends upon the point of view. Colostomy in such cases is a most meager palliation and the fact remains that in

nearly 20 per cent. of such extremely advanced cases in which the radical operation was performed, a five-year cure was obtained.

2. Nephritis, 13 per cent.; usually an acute nephritis superimposed on a chronic process. Infections, hemorrhage and interference with the function of the bladder played a considerable part in its production. The post-operative subcutaneous introduction of fluids into the general circulation is most important in preventing this complication.

3. Undiscovered metastatic tumors, 10.5 per cent. Unfortunately, abdominal exploration does not always reveal such growths, especially when they are buried in the substance of the liver, by all odds the most common condition. Small areas of cancerous involvement in the peritoneum and posterior fatty tissue are also sometimes overlooked. Patients with metastatic cancer have little vitality and often die from exhaustion following an operation which would not have been performed had the true condition been known. By more thorough exploration some of these operations and deaths have been avoided, though not all.

4. Hemorrhage, 6.5 per cent. While no patient died from hemorrhage directly, two died from so-called secondary shock, due to loss of blood from poorly controlled hemorrhage. In the remaining cases in this group hemorrhage was the chief factor leading to infection and exhaustion. We have not found that extensive operations of themselves have added very greatly to the mortality unless accompanied by increased loss of blood. In other words, unless there has been hemorrhage, I have not seen shock, the patients being in excellent condition at the completion of the most formidable procedures.

Prolonged operations with great traumatism may cause shock without actual loss of blood, but the condition is the same, the blood being withdrawn from the general circulation and lying in the suddenly dilated venous trunks of the abdomen.

5. Obstruction of bowels following operation, 3 per cent. In closing the gap in the pelvic peritoneum to prevent the small intestines entering the space from which the growth has been removed, a continuous chromic catgut suture should be used. I lost two patients some time after operation from chronic obstruction of the bowels, because I had used interrupted chromic catgut sutures, and following the operation, part of the lateral wall of the small intestine had pushed through a little crevice in the suture line.

In one case death was due to the inclusion of both ureters in suturing the peritoneum to close the pelvic cavity. The ureters had been in full

## CANCER OF THE RECTUM AND RECTOSIGMOID

view but too much of the peritoneum and lateral structures of the pelvis were taken up in the suture in the attempt to secure a firm closure.

The remaining deaths were due to exhaustion and occurred usually some days or weeks after operation.

*Operative Disability.*—Asepsis leads to primary wound healing. We have had patients leave the hospital with completely healed wounds in sixteen days and return to their employment in thirty days. Infected wounds were often six to twelve weeks in healing, and three or four months occasionally elapsed before the patients returned to work.

*Function Following Operation.*—The best function that we have been able to obtain following operation has been after the tube method of resection described by Balfour and the C. H. Mayo method of direct end-to-end union between the end of the sigmoid and the anal canal. The Weir method of invaginating the growth through the anus—amputation and direct through-and-through suture from the mucous surface—has given excellent results, but the method of invagination can be practised in only a small number of cases. The attempt to save function, however, has been one of the most common causes of technical failures resulting in sepsis and death or failure to obtain permanent cure. In order to save function, modifications were made in the operative technic resulting in a less thorough eradication of the disease. Patients, as a rule, were willing to accept a definite increase in possible mortality and a reduction of prospects of permanent cure that the function so highly desirable might be obtained.

The manner of performing colostomy does not seem to have made much difference in the ultimate functional results, but, in any event, the opening should be made well above the pudendal hair, which, when soiled, tends to uncleanness and fecal odor. We have had good results with the Littlewood method, which places the colostomy in the waist line above the left anterior superior spine of the ilium. This obliterates the peritoneal space to the left of the colostomy and prevents the small intestine's becoming incarcerated and adherent in this situation. In two cases in our experience colostomy in the left rectus muscle was followed by obstruction of the bowels from this cause.

Mixter advises making the colostomy in the midline just beneath the umbilicus, and we have used this situation in a number of instances with satisfaction. The Mixter colostomy furnishes direct access to the lower sigmoid and rectum and facilitates cleansing, when made as the first stage of a two-stage operation. It also appears to be less liable to late infections in the blind end following the radical operation. Moreover, it rapidly terminates a midline exploration or radical opera-

tion by placing the colostomy in the upper end of the working incision, and the results are so satisfactory that we are employing it extensively.

Care in regard to diet, the development of a 48-hour habit of bowel movement and the use of a large amount of water as an enema to empty the large bowel thoroughly once in 24 to 48 hours, does much to render the management of a colostomy successful. The radical operation of Harrison Cripps, while applicable only to cancer of the low rectum and anal canal, gives marvelously good functional results. In those cases in which extensive dissections about the bladder, prostate, urethra, etc., have been made, the return of control of the bladder is sometimes slow. One of our patients lost control of the bladder to a large extent permanently, and catheter life is necessary. This patient is impotent.

*Permanent Cures.*—Of the 430 patients on whom a resection was done, 364 recovered from the operation. Eliminating those who were operated on less than three years ago, we have 33.3 per cent. who lived three years or more, and 28.3 per cent. who lived five years or more, after the operation. These percentages may be increased fairly to 37.5 and 35.8 per cents., respectively, by subtracting from our mortality figures the normal death-rates for corresponding ages for periods of three and five years, *i.e.*, 4.2 and 7.5 per cents.<sup>1</sup>

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<sup>1</sup> Medico-Actuarial Mortality Investigation Table.

## SARCOMA OF THE APPENDIX

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PRIMARY malignant disease of the appendix was not recognized until Merling, in 1838,<sup>1</sup> described a case of a girl who died of general peritonitis as the result of perforation of the appendix. The appendix was found to be thick and firm and the seat of hard, small tumors which he decided were primary carcinoma.

Since then new cases of primary carcinoma of the appendix were reported from time to time. However, a great part of the cases published would not stand an impartial criticism.

The early instances of primary malignant condition of the appendix, including those of Merling,<sup>2</sup> Prus,<sup>3</sup> Rokitansky,<sup>4</sup> Kolaszeck,<sup>5</sup> etc., can hardly be considered as authentic cases. The microscopical examination in these cases is either lacking or insufficiently described, so that the probability of the tumor being of an inflammatory nature suggests itself. In other cases, where the author admits an involvement of the walls of the cæcum, there is reason to assume that the appendiceal tumor is secondary to that of the cæcum. In routine examination of appendices we find at times an appendix which is the seat of a somewhat circumscribed nodule, located at or near the tip; microscopically they often show nests of spheroidal cells, of rather uniform size; although they bear resemblance to carcinomatous tissue, especially when they penetrate the muscle coat, yet we are inclined to believe that they are inflammatory in origin. For, were they of neoplastic nature, they should clinically be of a more malignant type, which, however, is not the case; it is well known that they rarely infiltrate the neighboring tissues or metastasize, and when removed do not recur.

We agree with Milner<sup>6</sup> that the above condition of the appendix, often recorded as carcinoma, is the result of inflammatory proliferation of the adenomatous and endothelial structure of the appendix. Orth and Borst<sup>7</sup> have pointed out that carcinoma-like formations may follow inflammatory proliferation of such tissues.

In deciding as to whether or not tumor-like formations of the appendix are neoplastic or inflammatory in nature, one ought to take into consideration the clinical side as well, rather than rely solely upon the microscopical examination of the appendiceal tumor. Bearing this in



mind, many a case published as primary malignant condition of the appendix would undoubtedly be put into the class of the inflammatory granulomata.

Meyer<sup>8</sup> has recently collected 269 cases of primary carcinoma of the appendix. We believe, however, that their occurrence is less frequent than the above figures would indicate. From a collection of over 2000 appendices removed by Dr. A. P. Condon at the Nicholas Senn Hospital and other hospitals of Omaha and its vicinity, we found only one case of malignancy (sarcoma)—the case which will be described below—and five instances of tumor-like formation of the above description, which we believe are of inflammatory nature.

Sarcoma of the appendix is of great rarity. What has been said above of carcinoma of the appendix applies as well, if not more so, to sarcoma of the appendix. Jones<sup>9</sup> has collected 8 cases of supposedly primary sarcoma of the appendix and added a case of his own. Powers<sup>10</sup> reported a case since then, bringing up the total to 10 cases. The report of another case, therefore, is of sufficient interest to warrant its publication.

The history of the case is as follows:

Mr. Keuhn, aged thirty-five, drug clerk. Family history, in regard to his present condition, negative. Had had pain and tenderness in right iliac fossa, which lasted several weeks. Personal history, well until several weeks ago; he had been in bed for a few days when Dr. A. P. Condon saw him. There was no fever; he was moderately tender in right iliac fossa; no rigidity; leucocyte count not made. Chronic appendicitis was the diagnosis and patient was operated on November 1, 1903. The appendix was enlarged to the size of a little finger; densely adherent to the wall of the cæcum; was friable, and this friability extended into the cæcum, so that in the manipulation a hole was torn into the cæcum at the base of the appendix. This was sutured and closed without drainage. He sat up in 2 weeks and went to work again at end of three weeks. The microscopical examination of the appendix proved to be sarcoma, as will be described below.

About four months later Dr. A. P. Condon saw this patient; he complained of a dull aching in the right iliac fossa, and a mass the size of a split orange could be felt in the fossa; it was moderately tender.

He refused an operation at this time, but several months after consented to an exploratory incision, and on June 8, 1904, a long incision to the inner side of the mass was made; this mass had markedly increased in size since seen a few months before.

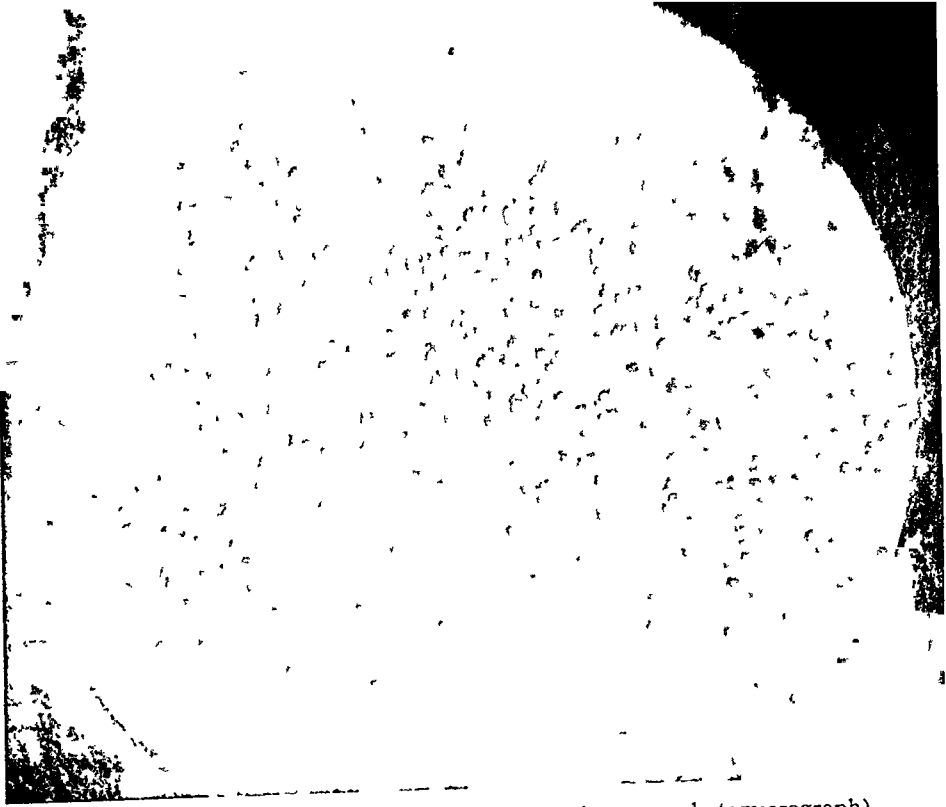


FIG. 1.—Round-cell sarcoma of appendix (high power photomicrograph)



## SARCOMA OF THE APPENDIX

Upon opening the abdomen there was a mass in the cæcal region the size of an infant's head, filling up the right iliac fossa, involving cæcum and ascending colon, and to this mass small intestines were adherent. The mesenteric lymph-nodes were not involved. No tissue was removed at this time, as the mass was believed to be a recurrent sarcoma. The patient died about four months after this exploratory operation.

*Macroscopical Examination.*—Appendix the size of the little finger, irregular and nodular. Peritoneal surface presents a gray-whitish appearance. Superficial vessels are not injected.

Appendix was torn near its middle (during removal). Upon incision the lumen of appendix is found to be obliterated; the walls of appendix thick and nodular throughout its length.

*The Microscopical Examination.*—Sections of the appendix show columns of cells of the round-cell type containing vesicular nuclei; the cells are of irregular size, they penetrate into the muscle coat and in some places seem to disorganize the tissue. Between the cellular elements is a very fine fibrillar stroma. A great number of small, embryonic capillaries, some of which contain tumor cells, are present. The mucous membrane entirely replaced by tumor tissue.

*Diagnosis.*—Round-cell sarcoma, as illustrated in Fig. 1. The diagnosis was confirmed by Dr. Frank Hall, of Kansas City, and M. Petit, of Paris.

Table I shows the cases of primary sarcoma collected from the literature.

From the available description of the cases published, we would exclude the case of Glazenbrook (endothelial sarcoma), which in our estimation is, probably, an inflammatory tumor resulting from proliferation of endothelial lining of lymph-spaces. Although the case of Guilford was ruled out by Kelly and Hurdon<sup>22</sup> and Rolleston and Jones<sup>23</sup> excluded the case of Bernays, yet we believe that their criticism is not well founded. This would leave a total of 10 cases of sarcoma of the appendix in the entire literature.

*Etiology.*—The predisposing factor in all of the cases was inflammation. This was also true of primary carcinoma of the appendix. Direct injury being of importance in sarcoma in other localities, for instance in the lower extremities, played no rôle in the cases of sarcoma of the appendix. Only in one case direct injury associated with the tumor formation could be ascertained (Jones). This, however, does not exclude injury by fecal concretions; as in the case of Guilford, the tumor was found to be formed around such a concretion.

*Age.*—The majority of cases reported occurred in the second decade. The youngest case being six years (Warren) and the oldest forty-five (Carvardine).

TABLE I.

Author	Year of publication	Sex	Age	Symptoms	Findings	Type of tumor	Result of operation
Guilford <sup>11</sup> . . . .	1893	Female	27	Chronic appendicitis for 13 years	Appendix adherent to colon and ileum, but no involvement of same	Spindle-cell sarcoma	No recurrence.
Warren <sup>12</sup> . . . . .	1898	Male	6	Intermittent pain and fever for a month	Glands at root of mesentery involved	Round-cell	Well after four years.
Paterson <sup>13</sup> . . . .	1903	Male	39	Uneasiness, occasional sharp pain in right iliac fossa for three months. Acute attack of vomiting before operation	Adherent appendix, and caecum thickened a quarter of an inch around appendix. Autopsy showed no trace of tumor elsewhere	Round-cell	Patient died six hours after operation.
Bernays <sup>14</sup> . . . .	1905	Female	29	Chronic appendicitis for one year	Adjacent wall of caecum involved	Round-cell	Two years after operation, tumor appeared in abdomen which was considered to be a recurrence.
Carvardine <sup>15</sup> . . .	1907	Female	45	Chronic appendicitis for five months. Attacks of diarrhoea and pain in right iliac fossa. Frequent attacks of severe colic	Appendix adherent and friable. Neighboring glands enlarged	Round-cell	Recurrence on left side and death nine months after.
Carvardine <sup>16</sup> . . .	1907	Male	..	Recurrent appendicitis. . . .	Some neighboring glands enlarged. Appendix buried in adhesions	Round-cell	Not stated.

# SARCOMA OF THE APPENDIX

Stewart <sup>17</sup> .....	1908	Male	35	Recurrent attacks of appendicitis	Head of cæcum covered with adhesions; mass friable. Appendix buried in centre	Fibrosarcoma	Not stated.
Jones <sup>18</sup> .....	1911	Female	26	Intermittent pain in lower abdomen for four years, following injury to right side. Before operation, constant pain in lower abdomen	Appendix hard, large at middle, elastic, nodular mass invading in places the wall of the appendix	Spindle-cell	Patient well at present time (personal communication from author).
Powers <sup>19</sup> .....	1911	Female	18	Attack of appendicitis for five weeks	.....	Round-cell	Patient died ten weeks after operation, having developed what was supposed to be a general sarcomatosis.
Wohl <sup>21</sup> .....	1916	Male	35	Chronic appendicitis.....	Appendix densely adherent to wall of cæcum; was friable, friability extending to cæcum	Round-cell	Recurrence after four months and death seven months later.
Glazebrook <sup>20</sup> .	1895	Male	55	Chronic appendicitis.....	.....	Endothelial sarcoma(?)	Tumor found at autopsy.

*Sex.*—While carcinoma of the appendix was noted by Harte<sup>24</sup> to be more common in the female and McCarthy and McGrath<sup>25</sup> recently reported 73 per cent. of their 40 cases occurred in females, sarcoma was equally present in both sexes.

*Symptoms and Diagnosis.*—All of the cases have given symptoms of subacute and chronic appendicitis. In the more acute cases, the condition is to be attributed to the tumor, favoring the precipitation of an acute attack of appendicitis.

In the chronic cases the tumor is to be looked upon as the direct result of the chronic appendicitis, bearing resemblance to chronic inflammation of female breast or ulcer of stomach followed by malignancy. A preoperative diagnosis of sarcoma of appendix was not made in a single instance.

*Treatment and Prognosis.*—The treatment of most of the cases consisted of simple appendectomy and resection of the enlarged glands of the meso-appendix, when malignancy of the cæcum and the appendix was suspected by the surgeon.

The prognosis in sarcoma of the appendix is less favorable than in carcinoma. While in the latter metastasis and recurrence is the exception, in sarcoma only three cases have remained free from recurrence; four cases have developed recurrence followed by death, and one case died six hours after operation.

*Conclusions.*—Sarcoma of the appendix is rare, there being reported in the entire medical literature only 10 authentic cases. There is great difficulty at times to determine histologically whether or not the condition of the appendix is of chronic inflammatory or of neoplastic nature. We would therefore urge, in deciding upon the diagnosis, to take into consideration both the clinical as well as the microscopical picture. Sarcoma of the appendix (especially the round-cell type), contrary to the viewpoint held heretofore, is highly malignant.

I wish to express my thanks to Dr. A. P. Condon for his courtesy in allowing me to use his material.

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## SARCOMA OF THE APPENDIX

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## FRACTURES ABOUT THE WRIST IN CHILDHOOD AND ADOLESCENCE\*

By A. C. BURNHAM, M.D.

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WHILE Colles's fracture has been extensively studied and is given due consideration in all modern text-books, fractures about the wrist in childhood and early life are less perfectly understood and do not receive the attention to which, in view of their frequency and importance, they are entitled. Notwithstanding the fact that Colles's fracture has been variously described by different writers and that it was probably imperfectly understood by Colles himself,<sup>1</sup> it is a definite clinical entity, and it is a mistake to include under the term all fractures of the lower third of the radius either with or without the involvement of the ulna.

In Colles's fracture the line of fracture is commonly from one-half to three-fourths of an inch from the styloid process running in a generally transverse direction across the bone to the ulnar margin. The tip of the ulna is usually fractured and slightly displaced. In children such a fracture is not common. On the contrary, the injury is very uncommon, the ordinary trauma such as would result in a Colles's fracture in adults resulting in another type of fracture in children, a condition requiring very different treatment based upon an understanding of the characteristic bony lesions.

The frequency of Colles's fracture in children has been variously estimated. Skillern found four Colles's fracture cases in a series of one hundred cases of fracture of the forearm in children. Some writers include all fractures of the lower third of the radius under the general classification of Colles's fracture, the percentage then being given much higher. The records of the surgical out-patient department of Vanderbilt Clinic show that during 1914 and 1915 there were 65 fractures about the wrist-joint, of which 15 occurred before ossification of the lower radial epiphysis. These fifteen cases represent injuries in patients from 3 years to 20 years of age and are the cases studied in the preparation of this paper. They include only one case which might be classed as Colles's fracture. This was a fracture of the wrist

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<sup>1</sup> "Mr. Colles, who had never had an opportunity to dissect a specimen of the fracture, speaks only of the symptoms and treatment. His only statement concerning the fracture itself is an incorrect one." Stimson in *Fractures and Dislocations*, 7th Ed., p. 311, 1912.

## FRACTURES ABOUT THE WRIST IN CHILDHOOD

occurring in a chauffeur 18 years old. The remaining cases include one fracture of the scaphoid, one fracture of the radius by direct violence and 48 cases of fracture of the radius, all showing characteristic lesions of Colles's fracture.

There is but little literature on the subject of fractures about the wrist in children, but recently Vulliet has studied these fractures and has divided them into three different classes according to the lesion. His series include 29 cases which he has classified as follows:

1. *Epiphysial Separation*.—There are four of these and two doubtful cases without displacement. They occur almost exclusively after the twelfth year. The epiphysis is usually displaced backward.

2. *Fracture by "Tassement"* (Stauchungsbruch).—This is the most common type. It is usually about two centimetres above the epiphysial line and shows a typical skiagram. The anteroposterior view shows very little. Only a slight irregularity is noticed along the borders of the bone. On the other hand, the lateral view shows the radius bent but not separated, the radial fragment being deflected dorsally. There were twelve of these fractures, four of which were the low variety and resembled Colles's fracture.

3. *Fracture of Flexion*.—The line of fracture may be near the epiphysial line or it may be 3 or 4 cm. above it. They include greenstick and complete fractures, the ulna being nearly always fractured. The lower fragment is displaced to the dorsum and to the radial side.<sup>2</sup> There were 11 of these cases.

Skilern has recently published a paper in which he described complete fracture of the lower third of the radius with greenstick fracture of the ulna. He found 32 of a series of 100 cases of fracture of the forearm in children were fracture of the lower third of both bones, and 13 of these cases were transverse fracture of the radius with greenstick fracture of the ulna. He believes that the cause of this particular lesion is almost constantly a fall while in motion, the fracture being "a resultant of the action of gravity with momentum." The line of fracture is high and the ulna is fractured at about the same level as the radius. Most of the cases were between nine and fourteen years of age.

In the study of the fractures about the wrist before ossification of the epiphysis, there is at once apparent a clinical differentiation between those occurring before and those after puberty, and they will, consequently, be discussed separately.

*Fractures in Younger Children*.—From our material of the last two

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<sup>2</sup> It is hard to understand why the flexion would not cause displacement to the palmar aspect rather than to the dorsum, as stated by Vulliet.

years it at once appears that the common lesion in young children is fracture of both bones and not fracture of the lower end of the radius. There is no separation of the epiphysis, which is in agreement with the experience of Vulliet, who found no cases under twelve years. Skillern records one case nine years of age and another eleven, but epiphysial separation before the twelfth year is most uncommon and in children under seven or eight years of age is of great rarity.

Six of the seven cases represent fractures of both bones, the other case showing greenstick fracture of the radius with the ulna apparently intact. In one case there is greenstick of the ulna (this corresponds to the type described by Skillern), the remaining cases being complete fractures of both bones.

The next most striking characteristic of these cases is that the radius is fractured considerably above Colles's site. Actually the measurements of the line of fracture average  $1\frac{1}{8}$  inches from the carpal margin on the ulna side and  $1\frac{5}{16}$  inches from the styloid. This compares with the following figures in adults: From the styloid to the line of fracture the measurement (average 40 cases) is a little more than  $\frac{7}{8}$  inch, while from the carpal margin along the ulna side of the bone the distance is a little less than one-half inch. In 40 consecutive cases of Colles's fracture no case showed a fracture more than  $1\frac{1}{4}$  inches from the styloid.

If we search for the cause of the fractures at this particular point in children, we find that the bones of children contain more cartilage towards the ends and are consequently much tougher at these points. The cancellous tissue extends much further toward the medullary canal than is the case in adults (Rixford). The history of these cases is often unsatisfactory because children have usually no clear idea of just how the accident occurred. In several of these cases the cause is given as a fall on the extended hand. In these cases the fracture is usually by compression or buckling. This is the common mechanism of fracture in young children and takes place most readily when the force is applied slowly. Where the force is exerted more quickly, one bone may be displaced and the other bone merely bent (greenstick fracture) enough to allow the displacement of the fragment as seen in the fracture described by Skillern. Where the force is applied still more suddenly and forcibly, as in falls from a height, both bones are completely fractured and displaced. It would seem then that the same force which produces Colles's fracture in adults could mechanically produce the type of fractures seen in young children. It would therefore appear that the typical fracture about the wrist in young children is fracture of both bones complete or incomplete.

## FRACTURES ABOUT THE WRIST IN CHILDHOOD

It might be noted here that it is not uncommon to have the clinical symptoms of fracture of both bones and find the X-ray negative, or showing a line of fracture in only one bone. It is exactly in these bending fractures in children that the X-ray is least reliable; the diagnosis should be based on the history and localized (wincing) tenderness, the X-ray serving only as corroborative evidence.

TABLE I  
WRIST FRACTURES IN CHILDREN UNDER TWELVE YEARS

No.	Name	Age	Sex	Radius	Ulna	Displacement
1	A. F.	7	M.	Complete	Complete	Dorsally, bones overlapping.
2	N. R.	11	F.	Greenstick	Intact	Anterior deviation lower fragment.
3	J. A.	9	M.	Complete	Complete	Lower fragment posteriority.
4	D. R.	19	F.	Complete	Greenstick	Anterior deviation of radius.
5	M. K.	7	F.	Greenstick	Greenstick	None.
6	E. K.	8	F.	Complete	Greenstick	Posterior deviation both bones.
7	R. A.	4	M.	Complete	Greenstick	Posterior and ulna deviation.

A glance at Table I is sufficient to show that the majority of fractures about the wrist in children are fractures of both bones. In two cases (cases 2 and 4) the anterior deviation would suggest that the injury might have been due to hyperflexion, while the remaining cases were probably caused by falls upon the palm with the hand extended.

It seems apparent that the same force applied to the palm might cause, depending upon the violence of the injury, either greenstick fracture of one or both bones, complete fracture of the radius with greenstick fracture of the ulna or complete fractures of both bones. The important point to be noted is that complete fracture of the radius is generally accompanied by fracture of the ulna, complete or incomplete, and that the occurrence of an injury to the lower portion of the forearm in children always suggests a fracture of both bones.

*Fractures in Adolescence:* After the twelfth year the fractures about the wrist easily divide themselves into two classes, the epiphysal separations (including fracture-separation of the epiphysis) and a second group, which might be termed the transitional group, representing lesions occurring between the sites of the fractures of childhood and those of adult life and having some of the characteristics of both types.

There were five cases of epiphysal separation, four occurring between the thirteenth and fifteenth years inclusive. As is well recognized, separation of epiphysis at the lower end of the radius is most

apt to occur during the twelfth, thirteenth or fourteenth years. Skillern gives a table of the sixteen cases in a series of one hundred cases of fracture of the forearm, the youngest patient being nine years and the oldest nineteen years, while over half occurred during the three years above mentioned.

This might be accounted for by the fact that during the early years the lower epiphysis is mostly cartilage and consequently firm and resisting. It is only after the eighth or ninth year that the epiphysis is of sufficient size to allow for the application of the necessary force to cause its separation, while in later years (from 16 years onward) the line of cartilage is very thin and so firm that the bone is often broken before separation takes place.

TABLE II  
EPIPHYSIAL SEPARATION IN OLDER CHILDREN

No.	Name	Age	Radius	Ulna	Epiphysial displacement
8	M. G.	15	Separation alone	Tip fracture	Dorsally.
9	A. P.	14	Fracture-separation	Tip fracture, slightly displaced	Dorsally and radially.
10	S. N.	13	Fracture-separation	Intact	Dorsally and upward.
11	M. S.	13	Separation alone	Intact	Dorsally.
12	J. B.	20	Fracture-separation	Tip fractured and displaced	Dorsally.

All of these cases gave the same exciting cause: A fall upon the palm with the hand extended. Several were treated for a time for dislocation of the wrist. It should be remembered that dislocation of the wrist is extremely rare, while epiphysial separation is very common. The importance of complete reduction is to be emphasized, for interference with the growth of the radius is a possible result of the failure to reduce a dislocated epiphysis.

In the transitional group there are but three cases. Two of these are greenstick fractures of the radius at a point  $1\frac{7}{16}$  inches from the styloid (curiously enough while occurring in boys of 13 years and 14 years respectively the measurements were exactly the same). The point is considerably higher than the average line of fracture in the adult and in both of these cases the lower fragment was displaced toward the palm. In the skiagraphs these fractures are seen only with the greatest difficulty in the anteroposterior view, but are readily apparent when the parts are radiographed in the lateral diameter of the forearm. In both cases the ulna was intact. In these cases the diagnosis could be easily made by the characteristic tenderness along

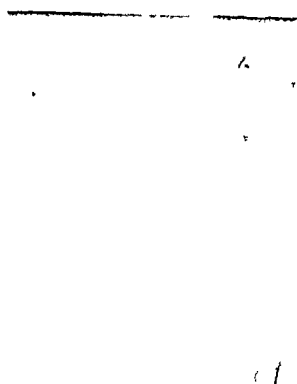


FIG. 1.—Case I Fracture of both bones in patient seven years old. Note the level of fracture and the displacement toward the radial side



FIG. 2.—Lateral view of Fig. 1. Note the displacement backward and upward

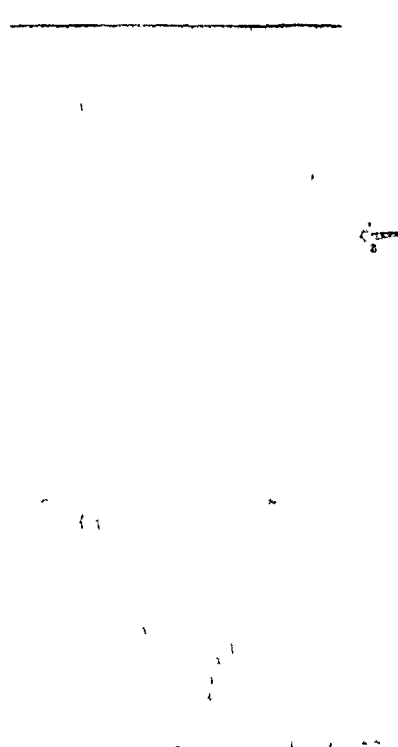


FIG. 3.—Case II Greenstick fracture of the radius in a girl of eleven years. The line of fracture is evident only on close examination. This plate shows no displacement

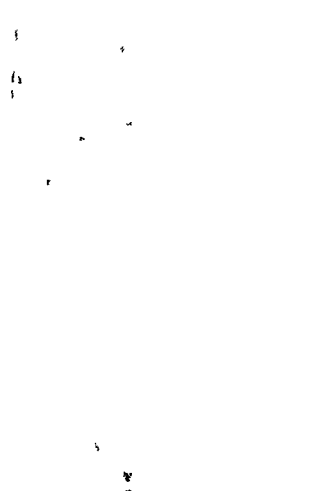


FIG. 4.—Lateral view of Fig. 3. Note the marked displacement as shown in the plate.

FIG. 5.—Separation of epiphysis, showing development of bones in the male. This plate is apparently negative.

FIG. 6.—Lateral view of Fig. 5. Note how clearly the separation may be seen in this view. The ulna is intact.

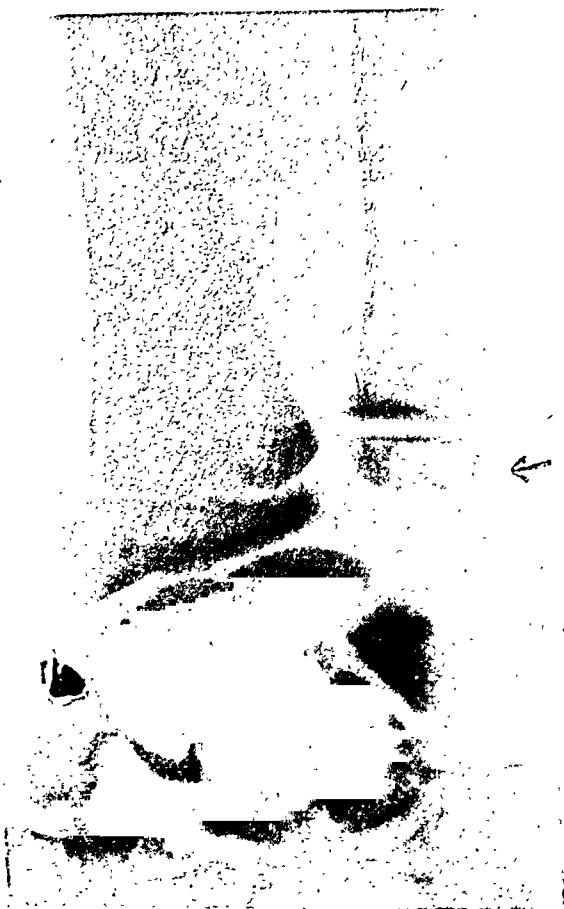


FIG. 7.—Case VIII. Epiphyseal separation in a boy of fifteen years. The tip of the ulna is fractured but not displaced.



FIG. 8.—Lateral view of Fig. 7. Marked displacement gives the appearance of dislocation of the wrist.

the line of fracture. They well illustrate the fallacy of depending upon a single radiograph, and this is true especially in the absence of false point of motion and crepitus.

It has been generally observed that when the classical symptoms of fracture were present almost any kind of radiograph would show the fracture, but when the diagnosis depends merely upon the characteristic history of trauma in combination with swelling and localized tenderness, it may require repeated radiographs before the line of fracture can be satisfactorily demonstrated. Indeed in some cases repeated X-ray examinations have been negative, the diagnosis finally being substantiated only after an interval of several weeks when callus formation becomes evident:

The third case in the transitional group was a fracture in a youth of eighteen years caused by cranking an automobile. This fracture was  $1\frac{1}{4}$  inches from the styloid and more than  $\frac{1}{2}$  inch above the epiphysial line. While the ulna was intact and the fracture much higher than the average Colles's it still had the general appearance and characteristics of Colles's fracture as it is seen in adults, and might well be classed as such. During adolescence fracture of the ulna does not often occur in combination with fracture of the lower end of the radius, in contra-distinction to childhood, when it is the rule rather than the exception.

From a study of many cases of fracture about the wrist in childhood and adolescence, among which the above cited cases may serve as typical examples, it appears that the following conclusions are justified:

1. Typical Colles's fracture is very uncommon before early adult life.
2. In childhood (that is before the tenth or twelfth year) the common type of fracture about the wrist is fracture of both radius and ulna either greenstick or complete.
3. Separation of the lower radial epiphysis is of frequent occurrence during the early part of the second decade and should be carefully differentiated from dislocation of the wrist, which is so rare as to be a surgical curiosity.
4. When fracture of the radius is suspected, either in childhood or adolescence, the line of fracture should be searched for at a point considerably higher than is the case when the same injury occurs later in life.
5. In the care of fracture of the lower end of the radius in early life the frequency of the associated fracture of the ulna must be constantly borne in mind, the treatment of the condition being modified accordingly.



## UNDESCENDED TESTIS \*

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*Theories as to Cause of Non-descent.*—At the end of pregnancy the testicle should lie at the lowermost portion of the scrotum. Why it is retained at some higher point in its migration from within the abdomen through the inguinal canal until it reaches the lower end of the scrotum is not clearly understood. No single theory will explain all of the cases and in all probability a combination of causes is present in the majority. It was formerly thought that the gubernaculum testis, a combined fibromuscular structure, played the chief rôle in pulling or guiding the testis to its final resting place. One will, however, often find a well-developed gubernaculum attached at one end to the testis and at the other to the lowermost portion of the scrotum, and yet the testis will be found lying within or just beyond the inguinal canal and cannot be brought down any further. In other cases it is true the gubernaculum is poorly developed and very short, but this is rather an exceptional finding. The view advanced by Büdinger is that the fixation of the testis by adhesions due to a foetal peritonitis is the cause of the arrest. Others believe that a very short mesorchium or peritoneal fold suspending the testis prevents the organ from migrating. Uffreduzzi has recently attempted to explain the arrest as a reversion to the condition found in the lower mammalia. In the majority of my cases, in addition to the marked fixation of the non-descended testis and of the hernial sac which is an almost invariable accompaniment of it, I have noticed a great deficiency in the development of the arching fibres of the internal oblique muscle and a weak conjoined tendon. We know that a well-developed internal oblique acts, in the normal individual, as a sphincter, to prevent the retraction of the testis by the cremaster muscle. I simply offer this as a contributory cause and as an additional reason why operation should be done early, inasmuch as little can be hoped for from non-operative treatment as long as the musculature of the inguinal canal is so poorly developed. There is no longer any question that the vaginal process of peritoneum (see Fig. 2) does not play any part in the descent of the testis. Murray and others have shown that this finger-like process of peritoneum precedes the testis into the scrotum. In fact, one must constantly be on the watch for cases where the testis lies high up in the inguinal canal, and yet the structures of the cord pass far down

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\* Read before the American Urological Association, April 18, 1916.

into the scrotum and back again along the outer surface of an empty hernial sac. The arrest of the normal course of the descent of the testis is probably due to a combination of causes, no single one of which will explain every case.

*Arrested or Non-descent (or retention) vs. Abnormal Descent.*—It is necessary to distinguish, clinically, between an arrest of the testis in its normal course and a deviation from such a normal direction. The gubernaculum testis is like a four-tailed ribbon. The four tails unite to form a single band, which is attached to the lower end of the testis. One of the four tails is attached over the pubic region, another over Scarpa's triangle, a third to the perineum, and the fourth, which is usually the best developed, extends to the lowermost portion of the scrotum. Under normal conditions the scrotal tail is supposed to pull the testis downwards. If this does not occur we may have the testis arrested in (a) the iliac fossa (abdominal retention or arrest), (b) the inguinal canal (inguinal retention or arrest), and (c) retention just beyond the external ring (upper scrotal type of arrest) (see Fig. 3). Now one can readily understand that if the testis is pulled in the direction of one of the other three tails of the gubernaculum a femoral, pubic or perineal variety of abnormal descent or ectopia would be the result (see Fig. 4).

*Relation of Hernia to Non-descent of Testis.*—As a rule, every case of arrested or ectopic testis is accompanied by an inguinal hernia of the indirect variety, the sac of which is subject to as many variations in contents as any other inguinal hernia. In two out of my thirty-eight operations a sliding hernia of the cæcum and appendix was found. A form of hernia which occurs almost exclusively in association with non-descent of the testis is the interstitial hernia (see Figs. 5, 6 and 7). In one of my cases this was of the interparietal, and in another of the subcutaneous variety (Fig. 8).

*Influence of Non-descent upon the Testis.*—The investigations of Eccles<sup>1</sup> and Uffreduzzi<sup>2</sup> have clearly shown that there is a marked atrophy of the secretory functions of the retained testis. This atrophy of the spermatogenic tubules begins quite early and at puberty there is a marked difference between the appearance of sections from normal and retained testes. About ten per cent. of the spermatozoa-forming cells remain intact in the adult, according to Uffreduzzi.

*Other Complications of Non-descent.*—I need only mention the more important of these: (a) inflammation, (b) torsion of the testis (Fig. 9),

<sup>1</sup> Non-descent of Testis. Monograph.

<sup>2</sup> Archiv für Klinische Chirurgie, vol. 100-101.

(c) tumor formation. In regard to the last named there is some difference of opinion. Eccles does not believe that there is a greater tendency for such a change than in a normally placed organ. From my own experience, I am inclined to agree with the view of Uffreduzzi and others, that the non-descended testis on account of its exposed position is far oftener the seat of tumor formation than the normal organ. It was formerly believed that the reason for the development of neoplasms in the non-descended testis was on account of being more subject to trauma in the inguinal canal. During the past six months my colleague, Dr. Kolisher, has removed a large teratoma of a testis lying in the iliac fossa. At a recent meeting of the Chicago Surgical Society, Dr. D. W. Graham reported a similar case.

*Indications for Operation.*—There is a great diversity of opinion in this respect, but the general tendency at present is to advise operation at an earlier age than formerly. My own position is that if the testis is within the inguinal canal, or just beyond the external ring, and cannot be brought well down into the scrotum, the operation should be done at as early an age as is compatible with the general condition of the child. I have operated as early as two and a half years, and do not believe anything is to be gained by waiting until the age of ten to fourteen years, because of the well-recognized lack of development of the secreting tissues in the retained testis. If the testis lies within the abdomen and does not enter into the canal when the child coughs or strains, I also operate much earlier than formerly. One must not overlook those cases in children with well-developed cremaster muscles and large inguinal canals. The testes will often be found in the scrotum at first sight, but as soon as one begins to examine, the testis is pulled into the inguinal canal. These are not cases for surgical interference, unless the condition is associated with a fairly large hernia or should persist after puberty. Not infrequently the development of the sexual characteristics of the male is a very tardy one in cases of non-descent, and a syndrome resembling infantilism may be present as a temporary or even permanent condition. This association of hypopituitarism with non-descent of the testis was present in a marked degree in one of my cases operated at the age of sixteen, and the infantilism persists in spite of the fact that both testes now lie well down in the scrotum. I have given pituitary extract to some of these cases without much benefit. In adults I believe that we should advise operation, because of the danger of torsion and tumor formation and on account of the accompanying hernia. The prognosis as to a possible recovery of spermatogenesis is not very good, however. In my opinion this ques-

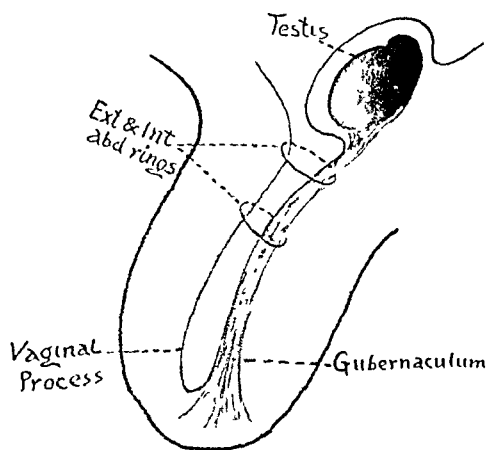


FIG. 1.—Action of normally developed gubernaculum in pulling testis down to lowermost portion of the scrotum. Note that vaginal process of peritoneum precedes testis.

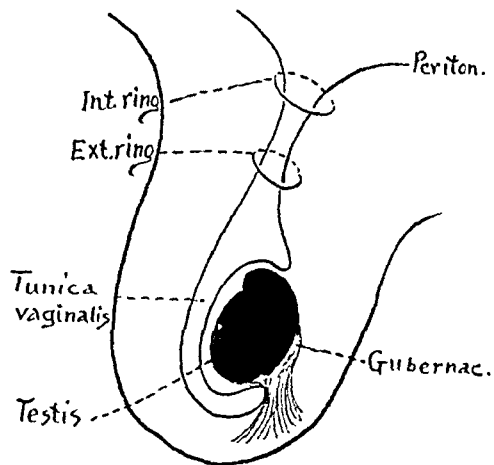


FIG. 2.—Testis in normal position at lowermost portion of the scrotum with obliteration of the vaginal process.

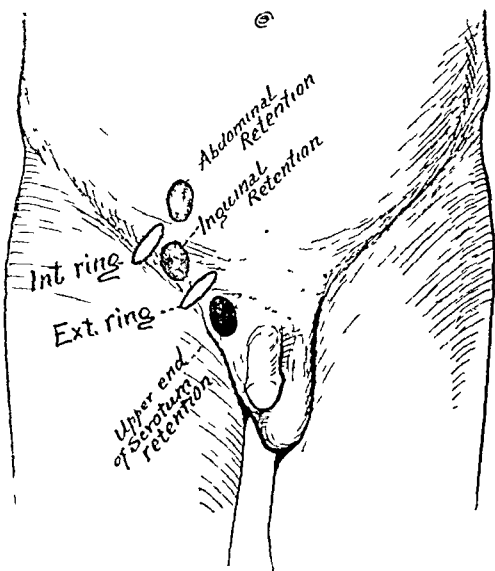


FIG. 3.—Various positions of retained (arrested descent) testis. Note location of abdominal, inguinal and upper scrotal testes.

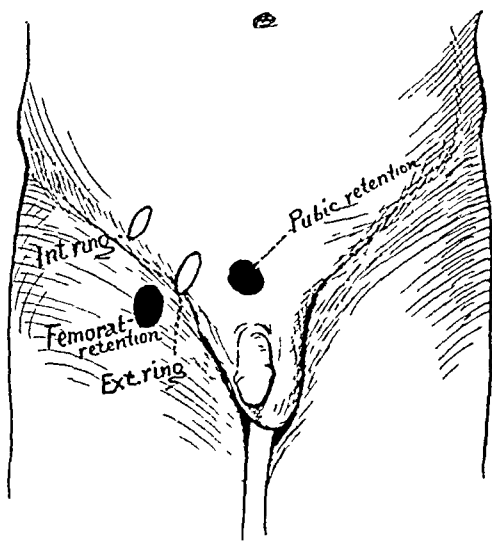


FIG. 4.—Location of pubic and femoral forms of ectopic or abnormally descended testis.

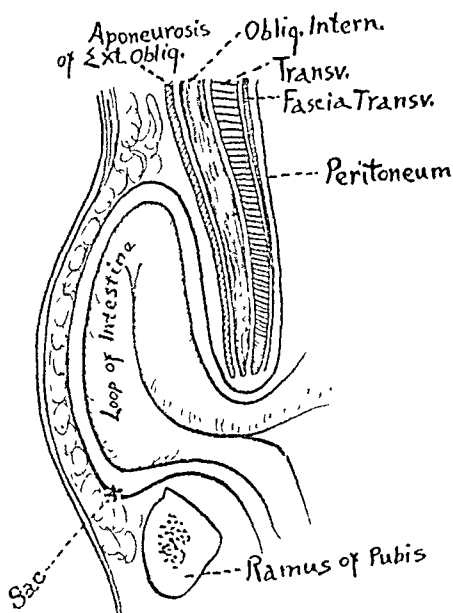


FIG. 5.—Relations (sagittal view) in subcutaneous form of interstitial hernia.

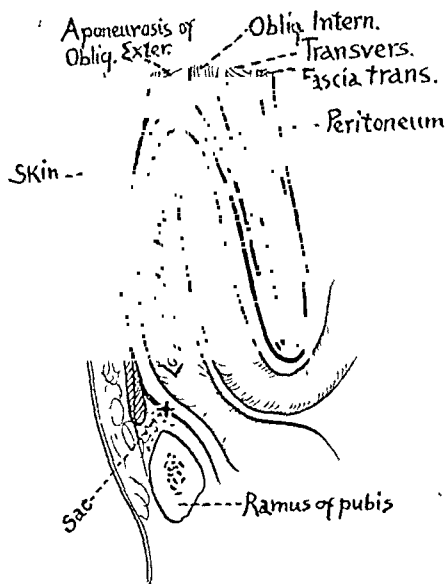


FIG. 6.—Relation in interparietal form of interstitial hernia.

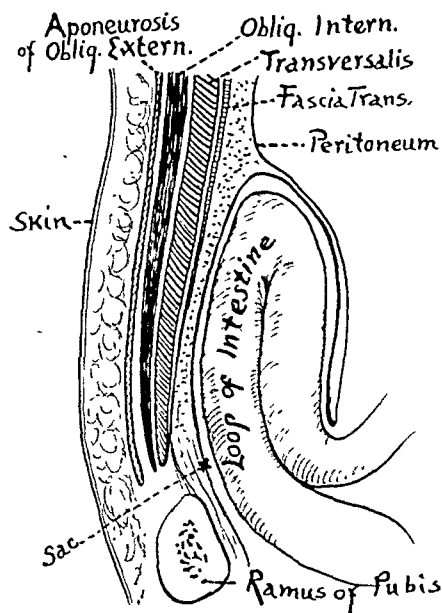


FIG. 7.—Relations in properitoneal form of interstitial hernia.



FIG. 8.—Subcutaneous form of interstitial hernia associated with non-descent of the testis (author's case). Note hour-glass form of the sac, the testis lying in the lower half, its position indicated by the dotted line.



FIG. 9.—Torsion of testis (own case). Note black hemorrhagic color of testis and epididymis.

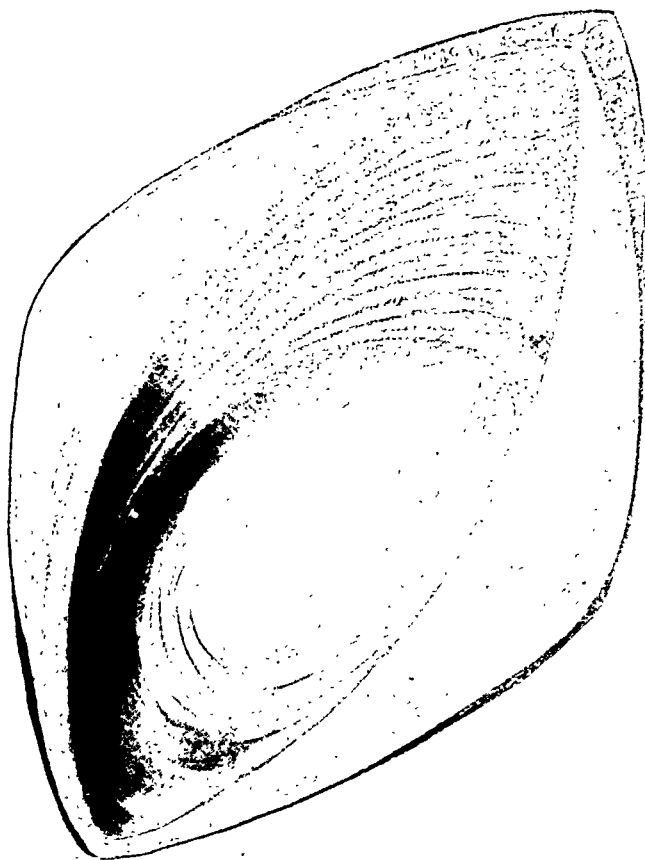


FIG. 10.—Note faulty development of conjoint tendon and of the internal oblique. External oblique aponeurosis divided and retracted to expose unopened sac and testis (on outer aspect of sac) lying in inguinal canal.

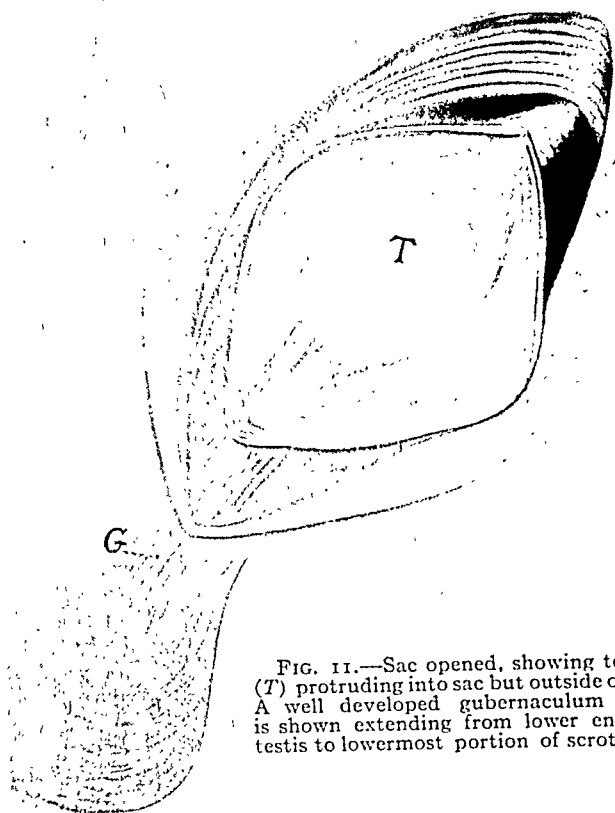


FIG. 11.—Sac opened, showing testis (*T*) protruding into sac but outside of it. A well developed gubernaculum (*G*) is shown extending from lower end of testis to lowermost portion of scrotum.

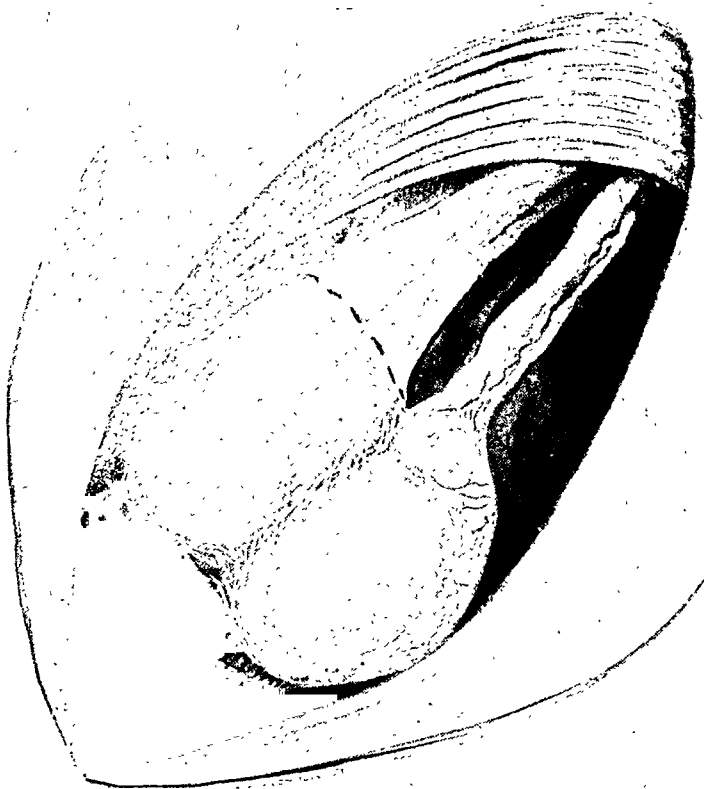


FIG. 12.—Vas and spermatic vessels separated from sac. Dotted line indicates level of division of sac before everting distal portion around testis (see Fig. 13). Gubernaculum has been divided close to testis.

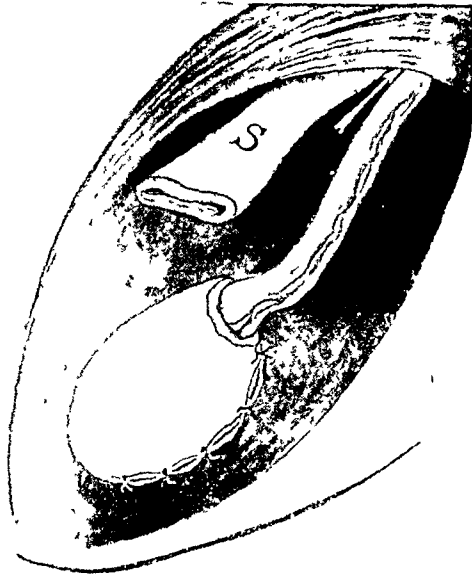


FIG. 13.—Step 2. Separation of vas and vessels in direction of arrow from non-ligated proximal portion of sac. + indicates position at lowermost portion of sac to which testis must be brought.

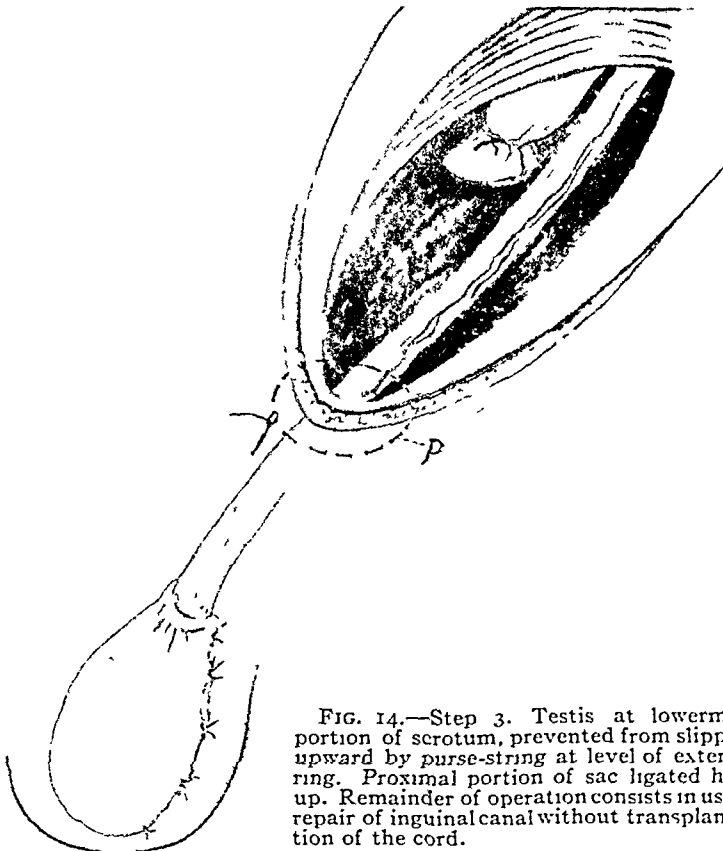


FIG. 14.—Step 3. Testis at lowermost portion of scrotum, prevented from slipping upward by purse-string at level of external ring. Proximal portion of sac ligated high up. Remainder of operation consists in usual repair of inguinal canal without transplantation of the cord.





## UNDESCENDED TESTIS

tion of the non-development of the spermatogenic cells is the most important one to consider in advising early operation. But little attention has been directed to a possible inter-relation between the various degrees of hypopituitarism and the non-descent of the testis. I have seen the retarded development of the male sexual characteristics or their entire absence. So often in cases of non-descent of the testis that I cannot help but feel that it is more than a coincidence.

*Treatment.*—The best method of operation, and one which takes into consideration the anatomical conditions more thoroughly than any other, is that first described by Dr. Arthur D. Bevan. In a series of thirty-eight operations, eight of which were bilateral, I have followed his technic and can warmly recommend it. It is hardly ever necessary if all of the steps are adhered to closely, to ligate the veins accompanying the vas. In one of my early cases it was impossible to bring the testis down into the scrotum without such ligation, and in the second case the veins were torn accidentally in a boy of five, with resulting gangrene of the testis.

In my last twenty-eight operations I have not found it necessary to ligate the vessels. The special points to which I wish to call attention, as the result of my own experience, are the extreme thinness of the hernial sac, and the small size of the structures in general in children. For this reason I now employ instruments small enough to do arterial work, and find that the handling of the tissues has been rendered far easier than before. One must always be prepared for some swelling of the testis following the operation as a result of handling the organ. This subsides within a few weeks without any special treatment. I will describe the various steps of the operation as performed at the present time, again expressing my appreciation of the work of Dr. Bevan, to whom I am indebted for the elucidation of many steps in the technic which seemed rather difficult before (see Fig. 10).

The inguinal canal is opened in the same manner as in the typical operation for inguinal hernia. The testis is found lying on the outer surface of the sac and the vas and its vessels most intimately connected with the exterior of the sac. The sac, testis and vessels are first freed from the surrounding tissues and the gubernaculum isolated, stretched out upon the fingers and carefully divided. One must not omit a search for a possible loop of the vas, extending down into the scrotum and back again, since in adults the vas often extends to a much lower level than the testis. The division of the gubernaculum (Fig. 11) renders the manipulation of the testis and sac an easier task. With fine blunt instruments the vas and the spermatic veins are carefully separated from the sac, if possible, without opening the latter (Fig. 12). The

vas and the vessels are then held aside with a catgut traction suture while the sac is opened and its contents reduced or otherwise cared for. The sac has now been opened and divided at the level indicated in Fig. 12, just above the proximal end of the testis. We now have a proximal and distal portion of the sac; the latter is now everted around the testis and its edges united with very fine catgut, preferably chromic. This eversion (Fig. 14) is necessary because of the frequent association of hydrocele of such a congenital hernial sac and this precaution is necessary to prevent a recurrence of the hydrocele. The proximal portion of the sac is best not ligated until the vessels and vas have been separated, as shown in Fig. 13, as high up behind the peritoneum into the iliac fossa as possible. One must be able, after this high separation made in the direction of the arrow of Fig. 13, to bring the testis down to the lowermost portion of the scrotum. I have never found it necessary to resort to the modifications of the operation suggested by Davison and by Wolfert. If one is patient and does not exert too much force in separating the vas and its vessels well up alongside the neck of the open, *i.e.*, non-ligated hernial sac into the iliac fossa, it is surprising how mobile the vas and its vessels become, so that one can bring the testis down to the desired point without unwise traction.

The testis is now held at the lowermost portion of the scrotum by an assistant, while a catgut purse-string (Fig. 14) suture is inserted through all of the structures at the external ring. The cord lies behind this suture which thus holds the testis and cord in the scrotum without any compression of the vas or its vessels. The remainder of the operation consists in the repair of the inguinal canal as for hernia without transplantation of the cord.

In conclusion let me urge that: 1. Cases of true non-descent or ectopic descent of the testis should be operated at as early an age as the condition of the child will permit, the lower limit being about two years. 2. Atrophy of the spermatogenic cells occurs in about ninety per cent. of the cases of retained testis, hence the necessity for early operation. 3. Tumor formation, torsion and the usual complications of the congenital hernia accompanying non-descent of the testis are not as rare as thought to be and must be taken into consideration in weighing the question of an operation. 4. Hypopituitarism is not the result of the non-descent, but an independent and not infrequent accompanying condition. 5. The operation for non-descent, *i.e.*, retained testis, has but little influence upon this lack of development of the male sexual characteristics and one should be guarded in the prognosis for such cases, as well as in the possible development of the testis after operations in young adults.

# ACUTE SUPPURATIVE PANCREATITIS. GANGRENE OF THE MAJOR PORTION OF THE PANCREAS. RECOVERY. DETERMINATION OF PANCREATIC FUNCTION THREE YEARS SUBSEQUENTLY

BY ROBERT TALBOTT MILLER, M.D.

OF PITTSBURG, PA.

(From Department of Surgery, University of Pittsburg Medical School)

THE great interest in physiological chemistry and the rapid development in this field have tended, during recent years, to focus attention upon the various glands of the body and their secretions. The pancreas was early submitted to study, and since the work of Mering and Minkowski many investigators have entered this field. This work on the pancreas has undoubtedly helped to stimulate interest in the general subject, resulting in our constantly increasing knowledge of the function of the thyroid, the parathyroids, the kidney and the liver. While development in this field may seem slow and halting, yet many important facts have been established and the knowledge of them is in current use by the practitioner in his daily routine. Undoubtedly, further advances in this field will broaden our therapeutic powers greatly.

The pancreas was among the first of the glands with a highly specialized secretion to be studied. The fact that this gland has both an internal and external secretion complicates the problem. In spite of the many tests devised to determine pancreatic function and of the great study devoted to this particular gland, we are still quite unable to gauge accurately the efficiency of the pancreas; in certain instances, of apparently healthy individuals, we are even unable to affirm that any part of digestion or of sugar metabolism is being performed by the pancreas. Oser (Nothnagel's *Encyclopædia of Practical Medicine*, American Edition, Diseases of Pancreas, 1905) points out that this confusion is due in part to the power of the body to compensate for the loss of the secretion of the pancreas; the gastric juice provides for proteolysis, the bile and succus entericus, together with certain bacteria in the lower bowel, for lipolysis and fat absorption, and the salivary and certain intestinal glands for amylolysis. In addition, there is to be remembered the general physiological law, according to which the body is provided with much more pancreatic tissue than is normally required; and, furthermore, that the pancreas is usually supplied with two excretory ducts,

either of which may become occluded without necessarily producing recognizable changes in pancreatic function in every instance, since the second duct, being patent, provides for entrance of the secretion into the bowel. "A considerable portion of the gland may be destroyed by acute or chronic inflammation, by hemorrhage, necrosis, new-growth or cysts, and the remainder of the gland may perform the function sufficiently, especially with regard to the internal secretion. But this is also conceivable for the digestive action, if at least one excretory duct is available." There have been a number of cases recorded in which the gland has been almost or completely destroyed without recognizable loss of pancreatic function. Körte reported a case of necrosis of the pancreas in which the urine immediately after operation was negative, but subsequently showed a permanent diabetes. Zweifel removed all but 3 cm. of the pancreas, with the result that transient diabetes appeared on the ninth day, to disappear at the end of seven weeks. Oser lists 11 cases of complete destruction of the pancreas by acute disease (2 cases), carcinoma (8 cases) and pressure (1 case), in no one of which was there diabetes. Fatty stools are commonly associated with pancreatic deficiency, but there have been cases of practically complete degeneration of the pancreas without altered fat absorption. Oser believes that an individual may show both diabetes and poor fat absorption and yet be perfectly free from pancreatic disease. Azotorrhœa, or faulty digestion of proteid, may follow total removal of the pancreas in dogs; yet Oser cites one dog that was so treated which lived forty-one days with "severe" diabetes, but without change in the appearance or composition of the stool. He concludes that the presence of numerous undigested meat fibres in the stool is "an important feature and deserves especial mention," but that azotorrhœa alone does not imply disease of the pancreas.

In a cursory search through quite a number of the standard textbooks, it has been found that almost without exception the authors confine their discussion of pancreatic function to that portion of the article dealing with chronic pancreatitis, while little or nothing is offered in the way of study of the pancreatic function in such individuals as have suffered grave injury or complete loss of the pancreas through acute inflammatory disease save the case of Körte, cited above, which is mentioned by Opie in Osler's *Modern Medicine*.

There is, of course, a general feeling of uncertainty concerning the study of pancreatic function from a clinical stand-point. Fault is commonly found with the various tests which have been devised while, as a matter of fact, our inability to study pancreatic function accurately is

## ACUTE SUPPURATIVE PANCREATITIS

probably due in part to the compensatory action of the other digestive juices, the presence of two ducts and the fact that a relatively small portion of pancreatic tissue is sufficient to carry on the complete function. Perhaps none of these factors can be recognized, yet any one of them may alter the problem. Deaver (*Surgery of the Upper Abdomen*, 1914, p. 274) remarks that were it possible to remove the entire pancreas of a human being by successive abstractions of small pieces of the gland, the various other juices allied to that of the pancreas would probably compensate for its loss.

In view of these facts, I submit the account of a case whose pancreas was in large part destroyed by acute disease. The patient recovered to enjoy perfect health; three years later a study of his digestion and sugar metabolism showed practically no variation from the normal.

CASE I.—Hospital number 1775. Admitted April 1, 1913. Discharged May 24, 1913. Diagnosis: *Acute suppurative pancreatitis*.

*Family History*.—Negative.

*Personal History*.—Patient has always been fleshy. He has had for a long time an abnormal appetite, eating six or seven full meals a day, and he has used alcohol in excess for a long time.

*Present Illness*.—Of forty-eight hours' duration, beginning with severe epigastric crampy pain, which later spread over the entire abdomen. The pain soon localized in the right lower quadrant and has since remained maximum at that point. He vomited several times at the onset and has since that time been unable to retain anything. The attack was preceded by rather severe constipation for three days, his bowels not moving in spite of the free administration of purgatives.

*Examination*.—Well-nourished, rather obese man, evidently suffering severe pain. Temperature,  $101.2^{\circ}$ , by rectum; pulse, 116; good volume and tension; leucocytes, 17,000. Cyanosis is not present. Chest negative. The abdomen shows moderate general symmetrical distention, the walls moving somewhat with respiration. There is marked general tenderness, which is maximum in the right lower quadrant and in the right flank. Tenderness is severe in the epigastrium, where there is corresponding muscle spasm. No masses are felt. There is no dulness in either flank. On rectal examination there is found acute tenderness high on the right side, but without a palpable mass.

*Diagnosis*.—The error, so frequently recorded, was made again in this instance and the condition considered to be probably an acute appendicitis with spreading peritonitis. Immediate operation was made.

*Operation.*—Under ether anæsthesia the abdomen was opened through a low right rectus incision. A large quantity of sero-purulent fluid escaped, and, in the region of the cæcum, thin bloody pus was encountered. Much to our surprise, the appendix appeared normal, excepting for injection of its peritoneal coat, which condition was also present over the cæcum and adjacent bowel. Further exploration then revealed a mass in the epigastrium, which was exposed by a high rectus incision. The mass evidently involved the pancreas, which was exposed by tearing bluntly through the transverse mesocolon and found to be tremendously swollen throughout, of a dark bluish-red color and quite friable. In the fat of the mesocolon were observed fine yellowish points, evidently foci of fat necrosis. The tissues in the region of the first and second portion of the duodenum were likewise deeply cyanotic and quite friable. The gall-bladder was markedly distended. No perforations were found in either stomach or duodenum. Free drainage was established in the region of the pancreas and the abdomen closed.

Following operation, the patient was desperately ill for forty-eight hours and then began to improve. Three weeks later a high retroperitoneal abscess was identified and opened through an incision beneath the right twelfth rib, allowing the escape of a large amount of foul-smelling pus. Irrigation of this wound brought away, from time to time, small pieces of grayish-white necrotic tissue, and, on the fourth day, there was discharged a rather large œdematous slough; the structure of this tissue was largely destroyed, but there still remained its contour and enough of its microscopic detail to identify its source (Fig. 1). The pathological laboratory (Dr. Oskar Klotz) returned the following report upon this tissue:

*Macroscopic.*—The specimen consisted of a loose grayish tissue  $6 \times 2 \times 1$  cm. The tissue was made up of many small nodular lobules which were bound together by a very loose connective-tissue stroma. The stroma appeared in part necrotic and rather gelatinous. The small lobules looked like pancreatic tissue, but they were very loosely bound together. They were of a gray appearance and frequently showed a white granular character. The white masses looked like fat necrosis, though they were associated directly with the small lobules. True fatty tissue was not present.

*Microscopic.*—Sections of the tissue show a structure in which no nuclei could be made out. The entire tissue stained pale pink and was subdivided, similarly to that seen in the pancreas. There was no evidence of inflammatory reaction. The connective tissue, fat and parenchymatous tissue appeared entirely necrotic. In some places the necrosis had left the general architecture of the tissue intact, so that former small alveoli were

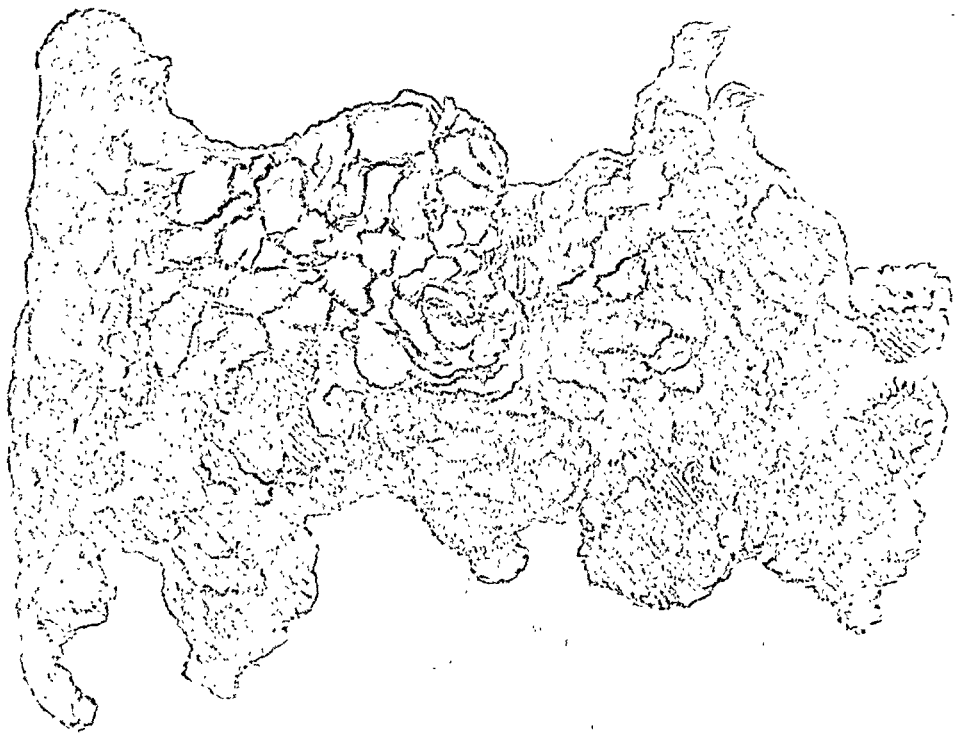


FIG. 1.—Slough of the pancreas discharged from the wound several days after the opening of a high retroperitoneal abscess, due to acute gangrenous pancreatitis. One and a half times natural size.





## ACUTE SUPPURATIVE PANCREATITIS

well bounded by connective tissue, although without evidence of any nuclei. In other places the destruction of the tissue was accompanied by a disintegration of the parts, so that nothing remained of the original characters of the tissue.

In places where the fat tissue had undergone necrosis, fine spicules were seen amidst the débris, indicating the position of some former crystals. These areas, too, showed a more intense and darker staining by hæmatoxylin, due to the deposit of calcium salts.

*Diagnosis.*—Necrosis of pancreas. Fat necrosis of pancreas.

Evidently the major portion of the pancreas had been destroyed and discharged from the wound. Following this, the patient made a rapid recovery and was soon discharged from the hospital.

October 15, 1915; Two and one-half years after his acute disease the patient again presented himself for observation. During this interim he had resumed his former life. On several occasions he had taken large quantities of alcohol for a more or less prolonged time and he had again established the habit of eating four or five very large meals a day. The patient applied for relief from "abdominal cramps." After two weeks in the hospital on regulated diet his condition seemed altogether normal; however, opportunity was taken to study his pancreatic function, the detail of which study follows:

October 15: Urine shows marked reduction of Fehling's solution. Positive fermentation. Quantity of sugar, 1 per cent. Patient placed on carbohydrate-free diet.

October 16: Total amount of urine for twenty-four hours, 2600 c.c. Fehling's test negative. Cammidge reaction negative.

October 17: Twenty-four-hour specimen of urine, 1900 cc. Sugar negative.

October 18: Twenty-four-hour specimen of urine, 2500 c.c. Sugar negative.

October 19: Blood sugar 0.09 per cent.

October 20: Patient given 50 gm. of glucose by mouth. Specimens of urine collected in three, six and twelve hours. Tests for sugar in these specimens all negative.

October 22: Patient given 100 gm. of glucose by mouth. Specimens of urine collected at three-hour intervals. The first specimen voided, namely, three hours after the ingestion of glucose, showed the faintest reduction of Fehling's solution, while the remaining specimens were all negative.

October 23: Patient put on Schmidt-Strassburger diet. Daily specimens of stool sent to laboratory.

October 25: Stool examination as follows: Homogeneous, normal sized stool; bile present; blood negative; parasites negative. Microscopic slide No. 1: Examination for meat fibres; no residue of meat found. Microscopic slide No. 2: Treated as follows: 1 drop 50 per cent. acetic acid

added to one drop of stool emulsion, heated just to boiling point, cover slip placed on at once and examined under the microscope. No evidence of fat, fatty acids, or soaps. Microscopic slide No. 3: 1 drop of stool emulsion placed in 1 drop of Soudan 3. Examination at once showed no evidence of neutral fats. Microscopic slide No. 4: 1 drop of stool emulsion, plus 1 drop of iodine and potassium iodide solution. Examination at once showed no undigested starch.

Summary of examination: Patient on admission showed 1 per cent. sugar in the urine. Immediately before admission he was apparently on an excessive carbohydrate diet, consisting of large amounts of bread, sugars, jellies and beer, his carbohydrate intake evidently exceeding his tolerance. This glycosuria cleared up immediately under carbohydrate-free diet. After the ingestion of 100 gm. of glucose, there was an exceedingly faint reduction of Fehling's solution; hence the patient's tolerance is just 100 gm., which is the lower limit of normal. The blood sugar, while the patient was on the carbohydrate-free diet, was 0.09 per cent., which is normal. From these facts we may conclude that his sugar metabolism is being maintained at the lower limit of normal.

As regards the digestion on the Schmidt-Strassburger diet, the macroscopic and microscopic examinations of the stools indicate very definitely that the digestion of normal amounts of meats, carbohydrates and fats is complete.

In view of the extensive involvement of the pancreas at the time of his original attack, we may be certain that such pancreatic tissue as did not slough away was subsequently markedly fibrosed. It is quite possible, then, that this individual's normal digestive balance and sugar metabolism are being maintained by other secretions than that of the pancreas, although one could not determine to what extent that portion of the necessarily sclerosed pancreatic tissue still present is able to carry on pancreatic function. It would be of great interest to study a series of cases with reference to the ultimate effect of acute destructive disease of the pancreas on its function. The writer has encountered no extensive series of this character and hence feels the above case to be worthy of record.

The writer acknowledges with thanks the help of Dr. R. R. Snowden in the determination of this patient's condition and of Dr. H. H. Permar in the preparation of the appended illustration.

## AMŒBIC ABSCESS OF THE LIVER \*

BY ALFRED C. WOOD, M.D.

OF PHILADELPHIA

ABSCESS of the liver may result from a number of conditions. Writers on the subject mention as the more common causes, the following: Traumatism, extension from adjacent suppurating foci, parasites, gall-stones, infection through the portal vein (from appendicitis and other lesions of the alimentary tract), infection through the hepatic artery from certain septic conditions (otitis media, ulcerative endocarditis, typhoid fever, etc.), and tropical dysentery. The latter condition gives rise in a certain number of cases to the so-called amœbic or tropical liver abscesses. As the case to be reported appears to belong to this class, the other forms will not now be considered.

Members of the white races, who visit certain tropical countries, are very subject to amœbic dysentery. Although dysentery is common in both sexes and at all ages, abscess of the liver occurs chiefly in adult males. It has been stated that men are affected thirty times as frequently as women. In the absence of any explanation as to how these figures were obtained, the question arises whether this ratio may not correspond with that of the two sexes visiting the tropics. The natives are relatively immune to dysentery and hence to amœbic abscess of the liver.

Tropical liver abscess may be latent, or at least develop without any manifestations that attract attention to the seat of trouble. The usual symptoms are, in addition to dysentery (or a history of a previous attack), pain in the right hypochondrium, commonly reflected to the back and right shoulder, fever, acceleration of pulse and respiration, leucocytosis, sallow skin, furred tongue, loss of appetite, digestive disturbances, and weakness.

The physical examination will show restricted respiratory action in the right lower chest, increased liver dulness, tenderness to pressure, upper right rectus rigidity, etc. Involvement of any adjacent structure from extension of the infection will modify or add to the above, in accordance with the part affected. Examination with the fluoroscope will reveal the enlarged liver area, and more or less restriction of motion of the diaphragm on the right side.

Abscess of the liver, if not relieved, leads to a fatal termination

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\* Read before the Philadelphia Academy of Surgery, April 3, 1916.

from septicæmia, with or without secondary involvement of adjacent organs or cavities. We have no reason to suppose that a cure may be obtained by any other means than evacuation, either spontaneously or by surgical aid. It is stated that about 28 per cent. rupture, and that rather more than one-half of these empty into the pleural cavity or lung. Cases are reported in which the discharge took place into the peritoneal cavity, gall-bladder, stomach, duodenum, colon, and inferior vena cava. Such a case may under exceptional circumstances recover, but the risk is too great and the outcome too uncertain to permit the pus to take one of these courses.

Some form of operative relief must therefore be considered. Aspiration is recommended by some, and one gets the impression from the literature that the trocar and cannula still have a place in the treatment of these cases. While special indications must always be given due consideration, an increasing tendency is apparent, in the absence of pointing or other guide to the focus of suppuration, to open the abdominal cavity and in this way to locate and deal with the abscess in the most direct and thorough manner. Introducing a needle into the liver through the chest wall as a means of locating an abscess, unless the latter be very large, is not to be relied upon as conclusive, if no pus is found. Of course, if pus is thus obtained the diagnosis is established. It is very properly urged by some recent writers that even this exploration should not be undertaken without having made every preparation to proceed at once to secure adequate drainage if the abscess is located. The needle should invariably be allowed to remain as a guide, until the focus of suppuration has been adequately drained. The reason for this injunction will appear in the following quotation. "It is surprising how many exploratory aspirations have been made without disclosing a large abscess, and how many times, when pus is shown by aspiration, and the needle removed, it has been impossible to find the abscess at operation performed later." (W. J. and C. H. Mayo.)

A minor detail developed in this case that seems sufficiently important to record. The aspirating needle was introduced into the liver at several points, sometimes without any result, and occasionally a few drops of blood were obtained. In one or two instances, the appearance of the fluid suggested a slight admixture of pus. Dr. Austin, who was present, examined the fluid with the microscope and reported it entirely free from pus. When the abscess was finally tapped, the fluid obtained could not have been distinguished by the naked eye from blood obtained from the seat of a severe, chronic congestion, but when a drop was placed under the microscope, Dr. Austin at once reported the presence

## AMŒBIC ABSCESS OF THE LIVER

of pus. Without this help, the search would no doubt have continued further, and the collection might even have been overlooked. On the other hand it prevented further investigation at one or two points where the blood obtained had a "suspicious" appearance. This difficulty would probably not occur in abscesses of longer standing, as the purulent characteristics would be more fully developed.

As 70 to 75 per cent. of these abscesses are located in the right lobe, and most frequently in the upper and posterior part, when exploratory puncture is decided upon, the needle should be introduced in the eighth or ninth intercostal space, in the posterior axillary line. The intelligent manipulation of the needle will be greatly facilitated if guided by visual inspection through a previously made abdominal incision.

Dependent drainage is desirable in these cases as elsewhere if it can be obtained, and to secure this it will be necessary in many cases to resect a portion of one or more ribs, usually the ninth or tenth in the axillary line. If the pleura is exposed it should be reflected upward, when possible, but if unavoidably opened, the two layers should be sutured together before proceeding to open the abscess. Whether it is advisable to suture the liver to the opening in the diaphragm or to protect the abdominal cavity by a gauze coffer dam must be decided at the time of the operation. The suture is recommended and is theoretically to be adopted, but it will not always be found practicable. In such cases proper gauze protection will be required.

In the case the report of which follows I adopted the plan of exposing the liver by an abdominal incision for the following reasons: First, the symptoms of liver abscess had existed but seven days, and it seemed reasonable to suppose that an abscess, if present, might be relatively small, hence easily missed by the uncertain method of introducing a needle through the lateral chest wall. Second, the patient appeared so ill that it would have been a serious, if not fatal, blunder to have overlooked the abscess. I was prepared, therefore, to make the most thorough exploration. Third, with proper technic, I believe it is a safer method than the blind use of the exploring needle.

The method was found to be very suitable in this case, as it is probable that either the intrahepatic or the extrahepatic abscess or both might otherwise have been missed.

The subjoined history appears to show that the amœbic infection occurred six years before the illness described. It may be assumed that the patient was the host of the amœbæ during all of this period. The symptoms of liver abscess developed three days after the beginning

of a severe attack of dysentery and seven days later the operation was performed.

It is to be noted that, although the patient has been cured of his liver abscess, the amoebiasis remains unchanged, notwithstanding the active use of emetine hypodermatically.

**CASE REPORT.**—A. V., male, aged thirty-three years, a sailor, was admitted on September 3, 1915, to the service of Dr. E. H. Siter, Hospital of the University of Pennsylvania, from the British Consulate, and was transferred to the medical service of Dr. Stengel. I am indebted to Dr. S. S. Leopold, house physician, and Dr. N. R. Goldsmith, house surgeon, for the following notes:

*Chief Complaint.*—Pain in the right hypochondrium, fever and malaise.

*History of Present Illness.*—Eleven days ago, the patient sailed from Liverpool, feeling well. Three days later, a very severe diarrhoea developed, lasting three days. He does not recall how often the bowels moved, but thinks it may have been 9 or 10 times during a four-hour watch. He describes the stools as liquid, grayish or brown, often frothy, but never containing blood or large amounts of mucus. Cramp-like pains were present in the abdomen; there was no vomiting at this time. Five days ago the patient became so weak that he was compelled to go to bed; he had severe abdominal pain which seemed to begin in the right hypochondrium and to radiate around to the back, up to the right shoulder and into the neck. The diarrhoea stopped at this time; the movements continued to be liquid, but occurred only about once a day. The patient states that he had a temperature of  $102^{\circ}$ , five days ago; does not know whether he had any fever before this time. He occasionally vomits large amounts of watery material; has been unable to retain anything but liquid for past five days; has never been jaundiced; complains of occipital headache. There has been no nose-bleed. The urine has a dark brown color.

*Past Medical History.*—The patient says he has been all over the world. He had blood poisoning 6 or 7 times; an attack of malaria fifteen years ago, and suffered from severe dysentery when in Buenos Aires six years ago. Three or 4 other men on the ship were similarly affected. He has never had typhoid fever; does not recall any other illness.

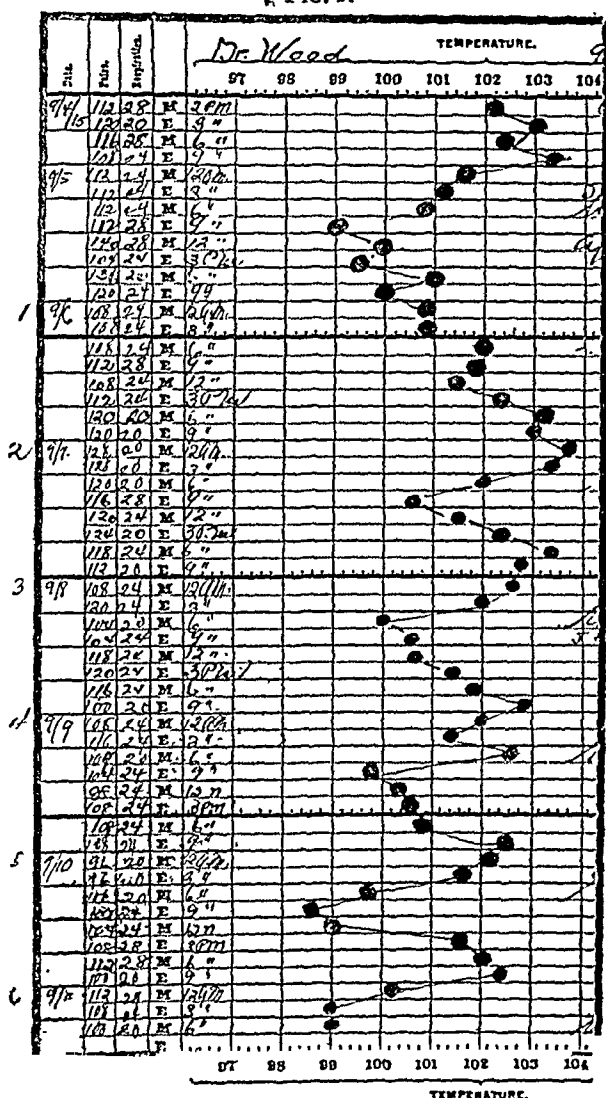
*Social History.*—He has been a seaman for fifteen years, the last position held being that of second engineer on a steamship owned by the Anglo-American Oil Company. The last two voyages were between Liverpool and America. He has used alcohol and tobacco to excess; has had two attacks of specific urethritis; but says he never had syphilis.

# AMŒBIC ABSCESS OF THE LIVER

*Family History.*—Negative.

*Physical Examination.*—The patient is a fairly well nourished, adult male, of good bony and muscular development, he has the appearance of being very ill. On admission the temperature was  $102\frac{1}{6}^{\circ}$ , reaching  $103\frac{2}{6}^{\circ}$  the same evening; pulse 108 to 120; respirations 20 to 28; white blood-cells 16,400; the eyes are dull;

FIG. 1.



FIGS. 1-4 show the course of the fever from the time of admission until the thirty-second day, after which the temperature remained normal.

the breath is intensely fetid. He complains of severe abdominal pain.

*The superficial vessels* are not sclerosed, the radial pulse is regular, of fair volume, and the two sides are equal and synchronous.

*The superficial lymph-nodes:* A few post-cervical glands are palpable; there is no general adenopathy.

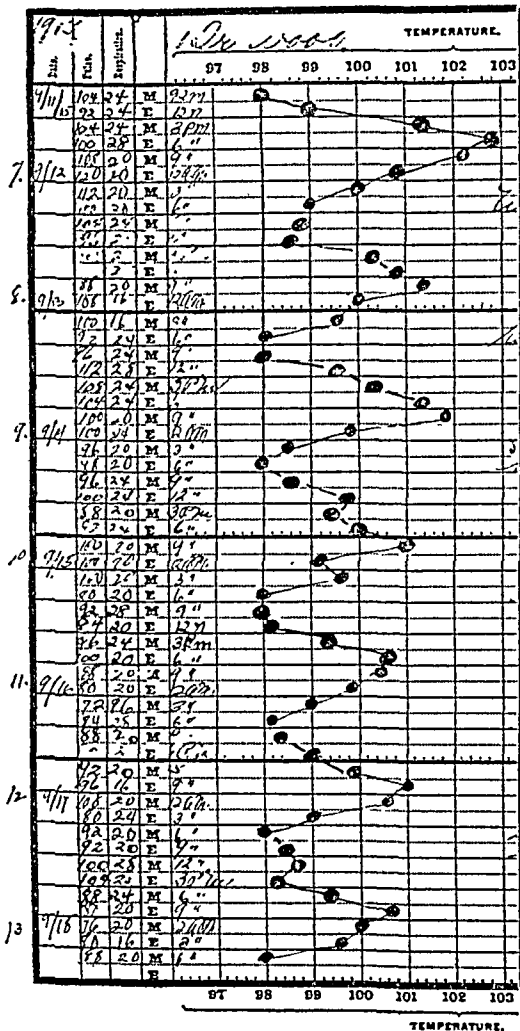


*Eyes:* Pupils are equal; irides react promptly to light and to accommodation; ocular movements free in all directions; the sclera are slightly icteroid; conjunctiva pale.

*Throat:* The tonsils and pharynx slightly congested.

*Tongue* is thickly coated with a dirty, whitish-brown fur, it is protruded in the midline; there is no tremor. The breath is

FIG. 2.



intensely fetid. The teeth are in poor condition. There is marked pyorrhœa, and many decayed roots. Several teeth are missing.

*Thorax* is somewhat emaciated; expansion fair.

*Lungs:* Normal to auscultation and percussion throughout. Right base moves but 2 cm. on deep inspiration.

*Heart:* Apex beat not visible nor palpable. Supracardiac dul-

## AMŒBIC ABSCESS OF THE LIVER

ness, first interspace  $7\frac{1}{2}$  cm.; second interspace 6 cm. Right base  $4\frac{3}{4}$  cm.; left base 12 cm.; right oblique  $4\frac{3}{4}$  cm.; left oblique 15 cm.; height 9 cm. The sounds are of fair quality, no murmurs are present, rate increased in frequency, second pulmonic is accentuated.

*Abdomen:* There is distinct rigidity in the right upper quadrant. Light palpation, even percussion, causes severe localized pain, most pronounced about 3 cm. below the costal margin, in the midclavicular line on the right side. There are no other areas of tenderness or rigidity; no fluid could be demonstrated.

*Liver* extends from the fifth rib downward for a distance of 19 cm. (by percussion) below the costal margin in the right nipple line. It is  $7\frac{1}{2}$  cm. below the ensiform, but cannot be felt.

*Spleen and kidneys* are not palpable.

*Extremities:* All reflexes are somewhat sluggish; no clonus; no Babinsky.

*Blood-pressure:* Systolic 118; diastolic 62; pulse-pressure 56.

Fluoroscopic examination shows arching and immobility of the diaphragm on the right side.

September 4, 1915: *Blood:* Red blood-cells 3,390,000; white blood-cells 15,800; hæmoglobin 61 per cent.; polymorphonuclears 87; small leucocytes 9; large mononuclears 2; transitionals 1; eosinophiles 1.

The Wassermann test was negative.

*Urine:* Slightly cloudy; dark amber; light flocculent sediment; specific gravity, 1024; reaction, acid; albumin, trace; sugar, 0; urobilin, +; faint trace bilirubin; a few hyaline casts; cylinders, 0; much mucus; occasional red blood-cell; white blood-cells, 10 to field; moderate amount squamous epithelium, crystals, 0.

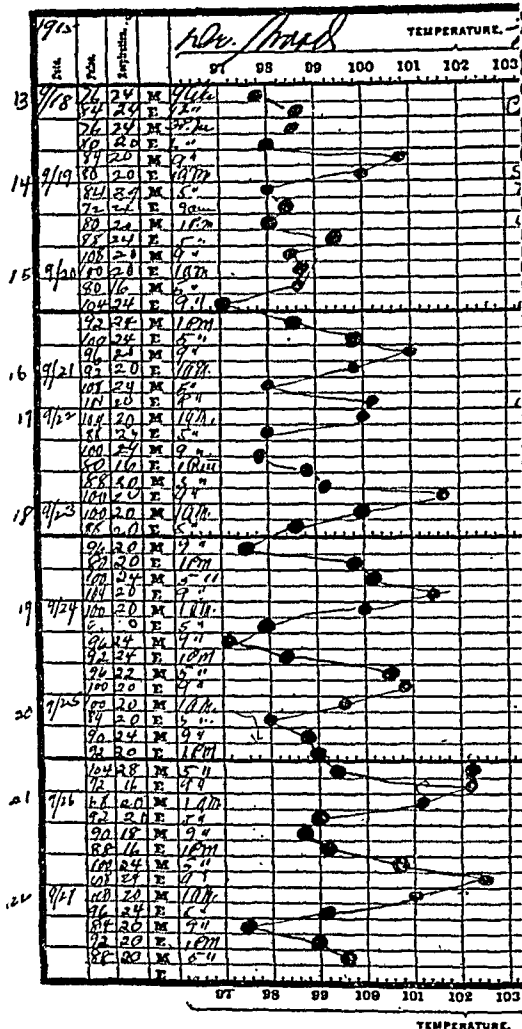
The outstanding features therefore were: following a profuse diarrhoea, pain in the right hypochondrium, radiating to the back, right shoulder and neck; fever; leucocytosis; rapid pulse; prostration; increased liver dulness; rigidity and tenderness in the right upper quadrant of the abdomen and increased arching with immobility of the diaphragm on the right side. The attack of dysentery six years before is to be kept in mind.

The diagnosis of abscess of the liver was made by Dr. J. H. Austin, with whom I had the privilege of examining the patient. Immediate operation was deemed necessary as the conditions present pointed to an extreme degree of sepsis. It may be added that subdiaphragmatic abscess, fluid in the right pleural sac as well as other causes of similar symptoms, were considered, but were ruled out by exclusion.

*Operation* (September 5, 1915).—Ether anæsthesia. A right, upper transrectus incision was made. The gall-bladder, stomach,

pylorus, duodenum and pancreas were normal. The liver was found much enlarged, and the upper surface more convex than normal. The appearance was such as to suggest a large abscess beneath the upper surface. After having protected the abdominal cavity with gauze pads, a large hollow needle, attached to an aspirator, was introduced into the suspicious area in different

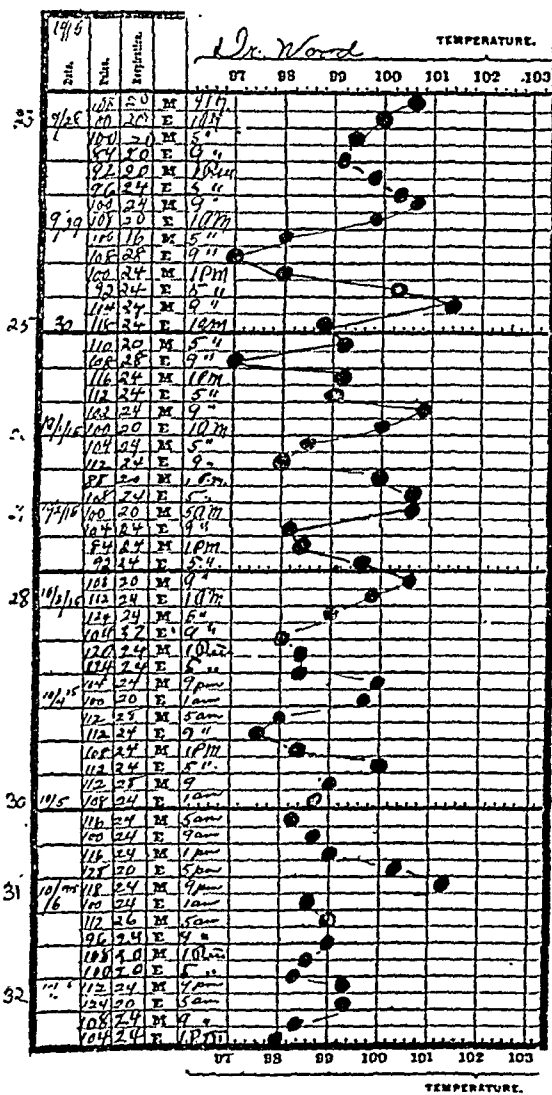
FIG. 3.



## AMŒBIC ABSCESS OF THE LIVER

which was removed by sponging. Further exploration of this area led to the conclusion that this small collection did not account for the patient's symptoms. It was then decided to introduce the aspirating needle in the neighborhood of the site usually recommended. The exact point selected in this case was the ninth interspace in the posterior axillary line, which corresponded

FIG. 4.



with the particular area of the right lobe of the liver that appeared most in need of investigation.

The direction of the needle was determined by inspection through the abdominal wound. By this method any portion of the liver adjacent to the right lateral abdominal wall may be systematically explored. An abscess was reached at a depth of about 3 inches. The needle was allowed to remain in place, while a

section of the tenth rib was removed and the liver freely exposed. The pleura was not encountered. After proper gauze protection, the liver was opened along the line of the needle and the finger introduced, the tip of the finger barely reaching the cavity. The matter drained had the characteristic brownish-red color. A rubber tube was inserted and the tract filled with a gauze tampon. Cigarette drains were placed in the abdominal wound and the incision closed about them by layer sutures of catgut. The patient's pulse was 164 per minute after the operation, but reaction was prompt and satisfactory.

September 6, 1915: Drainage not very purulent.

September 7, 1915: Gauze drains in thoracic wound removed; a large quantity of pus escaped. Gauze tampon inserted.

September 9, 1915: Discharge distinctly bile stained to-day.

September 11, 1915: Still draining profusely; general condition good.

September 14, 1915: Gauze drains removed. Still draining copiously.

September 19, 1915: Drainage tube removed from thoracic wound.

September 23, 1915: Anterior wound rapidly improving. The posterior wound still drains profusely.

*Blood*: Red blood-cells 2,620,000; white blood-cells 8900; hæmoglobin 40 per cent.

October 15, 1915: *Blood*: Red blood-cells 3,100,000; white blood-cells 12,300; hæmoglobin 49 per cent.; polymorphonuclears 76; leucocytes 15; mononuclears 3; transitionals 3; eosinophiles 3.

No amœbæ found in the discharge from the liver abscess.

*Fæces*: Acid; bile +; no amœbæ.

October 6, 1915: Clear bile is now being discharged from the posterior wound; anterior wound is nearly healed.

October 12, 1915: Diarrhœa continues.

October 15, 1915: Temperature practically normal. Examination of pus for amœba negative.

October 19, 1915: The bowel movement was sent to the laboratory of Tropical Medicine, in charge of Dr. Allen J. Smith, and was examined by Dr. Rivas, who reported as follows: "Fæces green and liquid. *Amœba histolytica* found in both the encysted and vegetative forms." One-half grain of emetine given hypodermatically.

October 20, 1915: Emetine, one-half grain given hypodermatically to-day.

October 21, 1915: Emetine, one-half grain hypodermatically.

*Urine*: Amber; flocculent sediment; specific gravity 1017; albumin trace; sugar, 0; casts, —; cylindroids, —; mucus, +; red

## AMŒBIC ABSCESS OF THE LIVER

blood-cells, —; white blood-cells, occasional; crystals, occasional.

*Blood:* Red blood-cells 3,530,000; white blood-cells 12,400; hæmoglobin 46 per cent.; polymorphonuclears 74; small, 26.

October 24, 1915: Diarrhœa continues. Draining profusely. Dr. Rivas reported the presence of amœba as in the previous examination.

October 28, 1915: *Blood:* Red blood cells 3,540,000; white blood-cells, 17,600; hæmoglobin 45 per cent.

November 1, 1915: Allowed up in chair to-day.

November 4, 1915: Diarrhœa continues; general condition better; drainage less profuse; incision rapidly closing. Dr. Rivas reported the presence of the encysted form of amœbæ in larger numbers than in either of the previous examinations. The vegetative form was also seen.

November 5, 1915: Emetine, gr. 1 (sterile ampoule), given hypodermatically.

November 6, 1915: Emetine, gr.  $\frac{1}{2}$  (sterile ampoule), given hypodermatically.

November 7, 1915: Emetine, gr. 1 (sterile ampoule), given hypodermatically.

November 8, 1915: Emetine, gr.  $\frac{1}{2}$  (sterile ampoule), given hypodermatically.

November 10, 1915: Drainage now contains pus, thin bile-stained material very scanty. General condition greatly improved. Diarrhœa has stopped.

November 12, 1915: Dr. Rivas found vegetative forms of amœbæ in fair numbers and a few encysted forms.

November 15, 1915: *Blood:* Red blood-cells 4,000,000; white blood-cells 17,700; hæmoglobin 74 per cent.

November 20, 1915: Patient up and walking about. No more gauze drainage.

November 26, 1915: Dr. Rivas reports the presence of amœba in large numbers in the fæces.

November 29, 1915: *Blood:* Red blood-cells 3,660,000; white blood-cells 12,600; hæmoglobin 47 per cent.; polymorphonuclears 62; small 34; leucocytes 1.

*Urine:* Straw; flocculent sediment; specific gravity 1018; albumin, faint trace; alkaline; sugar, 0; casts, an occasional hyaline; cylindroids, —; mucus, +; red blood-cells, —; occasional white blood-cells; epithelium, occasional; crystals, —.

December 1, 1915: Wound has fully healed, patient feels entirely well.

December 12, 1915: Emetine hydrochlor, gr. 1, hypodermatically.

December 15, 1915: Emetine hydrochlor, gr. 1 hypodermatically.

December 17, 1915: Emetine hydrochlor, gr. 1, hypodermatically.

December 19, 1915: Emetine hydrochlor, gr. 1, hypodermatically.

December 20, 1915: Dr. Rivas found the amœba present as in the previous examinations.

December 25, 1915: Patient exhibits no ill effect from emetine treatment. Amœbæ still present in the fæces, although patient is symptomatically entirely well, and is apparently now in good health.

January 5, 1916: Occasional slight attacks of diarrhœa.

February 1, 1916: Examination of fæces; amœbæ present.

February 10, 1916: Examination of fæces; amœbæ present; occult blood was present at every examination.

February 18, 1916: Patient has developed a scarlatinal rash (afebrile).

February 20, 1916: Diagnosed scarlet fever by Dr. Hartzell and sent to the Municipal Hospital.

The patient was returned by the Municipal Hospital to the University Hospital, April 4, having passed through an apparently typical (mild) attack of scarlet fever, followed by desquamation. He was in perfect health and appeared to be normal in every way. There had not been any tendency to diarrhœa.

He requested his discharge on the following day, to return to his former position. It is to be regretted that an examination for amœbæ was not made.

## SYSTEM OF KEEPING SURGICAL RECORDS\*

BY CHAS. H. FRAZIER, M.D.

OF PHILADELPHIA

IN an active hospital service, it is difficult for the chief of the staff to remember in detail the immediate results of the operations which he or his assistant has performed. It is important, therefore, that some system be adopted whereby he may review in abbreviated form large series of cases and in this way see for himself where mistakes have been made, which should be corrected.

In my service at the University Hospital, staff meetings are held once a week, at which all records of patients discharged not less than seven or more than fourteen days before are reviewed. If any important facts have been omitted they are introduced and the interesting features of the case are emphasized. I find this an excellent means of impressing upon the house staff the importance of accurate record keeping.

From this record is entered in a book a summary of the case, some twenty-five cases to the page, and in this summary is the file number, name, address, diagnosis, number of days in hospital, the name of the operation, and in addition the following:

Immediate result .....  
Asepsis maintained or not .....  
Complications, if any .....  
Comment .....  
Anæsthesia .....  
Anæsthesia complications .....  
End result (to be filled in one year later) .....

Under comment is recorded a reason, if apparent, for any mishap, such as wound infection, fatality, mistake in diagnosis and the like, and after Codman's suggestion, these are listed as follows:

Errors due to lack of technical knowledge or skill ..... E-s.  
Errors due to lack of surgical judgment ..... E-j.  
Errors due to lack of care of equipment ..... E-c.  
Errors due to lack of diagnostic skill ..... E-d.  
The patient's enfeebled condition ..... P-c.  
The patient's unconquerable disease ..... P-d.  
The patient's refusal of treatment ..... P-r.  
Delayed operation ..... D-o.  
The calamities of surgery or those accidents and complications over which we have no control ..... C.

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\* Read before the Philadelphia Academy of Surgery, April 3, 1916.



This method invites free and frank discussions on all matters pertaining to the case, the diagnosis, selection of operation, time and preparation for operation, technic and after-care. It is at once an analytical criticism or a critical analysis of the routine work of the clinic. As a result of this discussion modifications of technic suggest themselves, means of avoiding wound complications are proposed, and other matters that make for greater efficiency adopted. Above all, it stimulates, all along the line, a livelier and keener interest in the welfare of the patient.

The efficiency of a surgeon's record need not be measured in terms of brilliancy or number of operations per day. These are ephemeral matters. The surgeon's usefulness must be measured in a more telling way; in the percentage of accurate diagnoses, properly chosen operations, percentage of recoveries, the avoidance of wound infection, wisdom in choice of anæsthesia and the avoidance of anæsthesia complications, and, last but not least, the final result.

With a summary as above outlined available, the staff can review the last series of cases, a hundred or more, in a few minutes, and can see at a glance how many or how few errors are chargeable to the service.

## A SURGICAL "FOLLOW-UP" SYSTEM \*

BY CHARLES L. GIBSON, M.D.

OF NEW YORK

SURGEON TO THE FIRST (CORNELL) SURGICAL DIVISION, NEW YORK HOSPITAL

SINCE 1913 the following system has been employed by the First Surgical Division of the New York Hospital for the purpose of keeping its patients under observation after they leave the hospital.

At the time of a patient's discharge the following card is given him to prepare for the postal which is sent him three months later :

### NEW YORK HOSPITAL

8 West 16th Street

In three months' time a postal will be sent you, asking you to return to the hospital in order that you may be examined to determine your present condition. It is very essential that you come for this examination.

The nurse in charge of the ward enters his name and address in a diary under a date three months ahead of that of his dismissal; for example, a patient leaving January 1 will be entered in the diary under the date of April 1. These diaries are kept in the respective wards.

Each week the charts of the patients discharged the previous week are gone over by the stenographer, and the following cards are filled in with the data thus obtained :

*Diagnosis* Appendicitis, Acute.....*History No.* 195395  
*Name* G., Thomas.....*Age* 10. *Attend. Surg.* Dr. Gibson  
*Address* Bergen Street.....*Sex* M. *House Surg.* Dr. Schrock  
*Operation* Appendectomy .....  
*Admitted* July 9, 1914.....*Discharged* July 21, 1914  
*Subsequent course* .....

These cards are filed according to diagnosis, the classification being that of the Bellevue Nomenclature. Cases are also cross-referenced as to secondary diagnosis and death. The return notes are later written on these cards and one can readily look up the end results of any series of cases desired. Not only can the number of cases of a certain series be determined, as, for instance, a series of carcinoma of the stomach, but also the number of deaths, both in and after leaving the hospital, and the progress of the patients after their discharge. A separate alpha-

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\* Read at a meeting of the Practitioner's Society, March 3, 1916.

CHARLES L. GIBSON

betical name file is kept. These cards contain the names of the patients and the diagnosis under which their history cards can be found.

G., Thomas .....  
Acute appendicitis .....

A week before the date entered in the diary a postal is sent, requesting the patient to return the following week.

NEW YORK HOSPITAL  
8 West 16th Street

.....19....  
My dear M.....  
Will you kindly return to Ward.....  
on ....., at .....P.M.,  
as Professor Gibson desires to note the progress of his patients  
after they leave the hospital.  
Bring this card with you. If you cannot come, please write  
and tell us how you are.  
Signed.....  
House Surgeon.

At the time the postals are sent out, the cards of these patients are taken from the file and placed in envelopes bearing the name of the surgeon to whom they are to report.

When feasible, Sunday is the ideal day to ask patients to return, as many of them find it difficult or impossible to leave their work during the week. This plan, however, is better in theory than in practice, as on Sunday the wards are run with half the number of nurses ordinarily on duty, making any extra work decidedly inconvenient if not impossible, and the stenographer's services are also not then available.

Therefore, each surgeon has a separate specified time, one day each week, set apart for the purpose of examining his return cases.

On the day a particular surgeon's patients are to return, the cards of these patients are brought to the wards, and as each patient goes in for examination his card is sent in with him. After examination a note as to his present condition is dictated to the stenographer, and these notes are later typewritten on the cards which are then returned to the file.

*Diagnosis* Appendicitis, Acute.....*History No.* 195395  
*Name* G., Thomas.....*Age* 10. *Attend. Surg.* Dr. Gibson  
*Address* Bergen Street.....*Sex* M. *House Surg.* Dr. Schrock  
*Operation* Appendectomy .....  
*Admitted* July 9, 1914.....*Discharged* July 21, 1914  
*Subsequent course* .....  
Oct. 26, 1914. Scar firm. Good condition.

## A SURGICAL "FOLLOW-UP" SYSTEM

Patients whose condition is such that they must remain under observation are given a card bearing the date when they are to return for further examination,

### NEW YORK HOSPITAL

Patient's name.....  
Please return to ward.....  
On .....  
At .....

House Surgeon.

and their name and address again placed in the diary under this new date. This second entry is made by the stenographer. For instance, arrangements are made for all stomach cases to return as soon as possible after their first examination for bismuth series. Perforated ulcers of the stomach have in addition gastric analysis. These data are also placed on the history card.

*Diagnosis* Perforating duodenal ulcer.....*History No.* 202463  
*Name* P., Morris.....*Age* 43. *Attend. Surg.* Dr. Gibson  
*Address* East 5th Street.....*Sex* M. *House Surg.* Dr. Kellogg.  
*Operation* Suturing of perforation.....  
*Admitted* Oct. 13, 1915.....*Discharged* Nov. 13, 1915  
*Subsequent course* .....

Feb. 14, 1916. Feels well. No pain. Eats everything.

Has gained 13 pounds.

Feb. 15, 1916. Gastric analysis:

Ewald, 20 c.c. Comb., 30 per cent.

HCl, 64 per cent. Guaiac, 0

Total, 89 per cent.

Bismuth Series: X-ray plates 23823 a., 23833 a. show slight gastric retention.

The names and addresses of all patients not returning or not writing on the specified date are given to a worker of the Social Service Department, who endeavors to find some trace of them. She reports the results of her investigation to the stenographer, who makes whatever notes necessary on the history cards.

When the above system was first installed it was proposed to have every patient return first in three months' time, and then again at the expiration of another six months. After trying this method out it was found advisable to ask only the important cases to return more than once. For example, such cases as tonsils and adenoids, cellulitis, and other infective diseases are sent for three months after their discharge, and if found in good condition are considered cured and not sent for a second time. Carcinoma cases, however, are followed indefinitely.

Every three months a meeting is called by the Attending Surgeon, when he and the staff, including the pathologist, review the previous three months' cases with their return notes. The cases are discussed, and those of special interest are clipped with colored metal signals (each surgeon having a different color, Fig. 1) in order that they may be kept under observation.

This system of following up patients has been found to work out very satisfactorily. In spite of the shifting population of New York City with its large percentage of foreigners, 60 to 80 per cent. of patients either return or send some word concerning their condition. The past three months show a record of 70 per cent., the remaining 30 per cent. bearing the note, "Moved—address unknown."

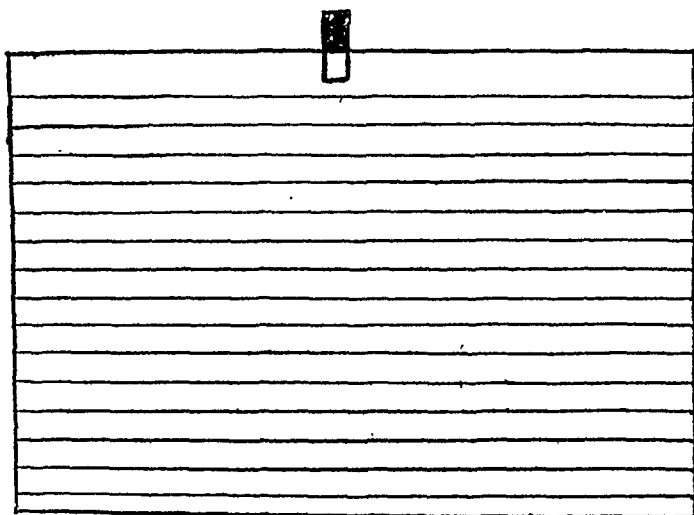


FIG. 1.

A feature of our system at the New York Hospital is our "Field Rounds." Every Monday at three, rounds are made with the attendance of the full staff, including the surgeon in charge of the Out-patient Department. Dressings are planned wherever feasible to be made at these rounds. A note is given to the stenographer in charge of the "Follow-Up" system on every patient in the hospital. Patients are told on discharge that if they ever want to see a doctor to come back for "Field Rounds" on Mondays. During their stay in the hospital they have learned the importance of this procedure and often present themselves after discharge for needed advice.

# TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

*Stated Meeting, held March 23, 1916*

The President, DR. CHARLES N. DOWD, in the Chair

## BORCHGREVINK'S EXTENSION SPLINT FOR SPIRAL FRACTURE OF THE HUMERUS

DR. H. H. M. LYLE presented a boy, 13 years of age, who, while wrestling, was thrown against a door and sustained a spiral fracture of the right humerus. The fracture was set at a sister hospital, but the result was unsatisfactory. After two attempts at reduction had failed, a Borchgrevink extension splint was applied, effecting a very satisfactory result.

This splint is simply a Y-shaped board, with a pulley at the lower end and a padded crutch for the axilla. Ordinary extension straps are applied to the arm and these are attached to a spreader below the elbow. From the spreader, a cord passes over the pulley and is attached to a doubled rubber tube by means of a wooden button. By shortening or lengthening the cord the desired amount of traction is obtained. If pressure in the axilla should arise, it can be relieved by passing a bandage over the crutch of the splint and around the perineum.

This simple splint gives an efficient, continuous extension, preserves the alignment and can be applied with the joints in semiflexion, thus fulfilling Zuppinger's dictum, "that the muscles must be relaxed in order to obtain efficient extension."

Borchgrevink's splint works day and night and provides extension and counter extension. An extensive experience not only in simple, but also in severe compound gunshot fractures, has led the reporter to consider this apparatus the simplest, the most comfortable and the most efficient splint for spiral and oblique fractures of the humerus.

## INTESTINAL OBSTRUCTION DUE TO TUBERCULAR LYMPH- NODES

DR. JOHN A. HARTWELL presented a boy, aged 13, who was admitted to the Cornell Division of the Bellevue Hospital on February 5 and discharged on February 22.

His illness had existed for only 5 days, nor had he ever had any

previous attacks similar to this and there was no history to indicate that he was not entirely healthy up to the beginning of the present illness.

This illness began with the typical symptoms of an acute abdominal inflammation. There was intense abdominal pain over the whole abdomen with frequent vomiting during the first day. Constipation had been marked from the first; there had been no movements from the bowels for 3 days.

Physical examination indicated no lesions outside the abdominal cavity. The abdomen was symmetrically distended to a marked degree. It was tender over its entire extent but rather more marked in the left lower quadrant. No masses could be felt. Rectal examination gave no additional information. Temperature on admission was 99°. Blood: Leucocytes, 24,000; polynuclears, 81 per cent.

The abdomen was opened immediately after admission and the following condition was found:

The mesentery contained a large number of tuberculous lymph nodes, at least two of which were ulcerated through the peritoneal covering. From each of these a firm band passed across the intestine. The lower one looped over the ileum at its entrance into the cæcum and was firmly attached to the iliac fossa in such a way as to cause a complete obstruction. The second one passed transversely across the abdominal cavity near the vertebral column and caused a partial obstruction about 10 feet proximal to the cæcum, so that there was a double occlusion of this much of the small intestine. This portion was markedly dilated and the peritoneal coat congested. Below the upper partial obstruction the bowel was not distended. The cæcum and colon were absolutely empty. Peritoneal cavity contained a small amount of blood-stained serum.

*Comment.*—The complete obstruction being at the ileocæcal valve, the distention had not yet reached the stomach and hence no vomiting. The backward regurgitation was also prevented to some extent by the second partial obstruction 10 inches higher up, so that the bowel above this showed no dilatation.

Dr. Hartwell called attention to the fact that this case presented two unusual factors:

1. That the obstruction was due to bands communicating with ulcerated tuberculous lymph nodes in the mesentery. There was no evidence of a tuberculous peritonitis. This in itself is a rare condition, as an acute intestinal obstruction from this cause does not as a rule occur.
2. The second point of interest is found in the fact that there were two distinct obstructions of the intestine, one at the ileocæcal junction

## CARCINOMA OF CERVICAL LYMPH-NODES

and the other about ten feet proximal to this, so that an actual double occlusion of this length of the intestine existed. This form of intestinal obstruction is especially severe, because the intervening loop rapidly fills with intestinal secretion, becomes very distended and there results a damage to the mucosa which permits of the rapid absorption of the intestinal poisons with early death. In this instance fortunately the boy came under observation just prior to this sequence of events and consequently made entirely satisfactory and prompt recovery.

DR. CHARLES N. DOWD recalled a case in whom a band, the result of tubercular inflammation, gave great difficulty in diagnosis. This band was about  $\frac{1}{8}$  inch in diameter and 3 inches long and stretched from one loop of intestine to another. When either of these loops became obstructed violent attacks of pain followed, together with the other symptoms of intestinal obstruction. He had undergone several emergency operations for this condition in various hospitals, but each time the band escaped detection. The distended condition of the intestine probably was the cause of these failures. After a period of observation, however, a time was selected when there was no distention and the lesion was easily found and removed.

DR. LUCIUS W. HOTCHKISS had had a similar case in a child about 5 years old. It was a complete intestinal obstruction at the lower end of the ileum, due to a band extending from a tuberculous gland in the ileocaecal junction which completely shut off the ileum. This patient also recovered.

## CARCINOMA OF CERVICAL LYMPH-NODES

DR. JOHN A. HARTWELL presented a man, aged 59, who was admitted to the Cornell Division of Bellevue Hospital on March 15, 1916, with the following history:

About 14 years ago the patient noticed a small swelling in the left side of the neck situated about 1 inch below the anterior border of the mastoid process. The tumor very slightly increased in size during the following 12 or 13 years. About 9 months ago it began to grow much more rapidly. There was no pain connected with the tumor. There has been no loss of weight and no impairment of general health. On examination at the present time the left side of the neck is found to be occupied with a very hard fixed mass which extends from the angle of the jaw down to the clavicle, a length of about 5 inches, and follows in general the course of the great vessels. Its lateral extension is about 3 inches; it lies beneath the sternomastoid muscle; it is not adherent to the skin but is firmly attached to the deeper structures of the neck. It is



evidently composed of a large number of hard lymph nodes matted into one general mass, except that near its posterior border 3 discrete lymph-nodes from  $\frac{1}{2}$  to 1 inch in diameter are distinctly palpable. Examination within the mouth shows no evidence of disease. The growth is in no apparent relation with the parotid gland, unless it be by means of a low cervical portion.

On March 15 an operation was performed originally with the intention of removing the discrete lymph nodes for diagnosis. It was then found that they were so easily removed that it was determined to make the attempt to excise the entire mass, which was accordingly done with surprising ease. While dissection was rather tedious, at no time was there any difficulty in separating it from the surrounding ulcer tissue.

A frozen section of the first node removed showed it to be carcinoma. The extent of the tumor is described in the operative note as follows:

"The tumor described below occupied the side of the neck, its upper margin lying directly against the tip of the styloid process and anteriorly and posteriorly to this directly up to the base of the skull. Its lower border impinges on the pleura behind the clavicle in the line of the entrance of the great vessels into the thorax. The greater part of the growth lies beneath the sternomastoid muscle and is bounded in front by the midline and posteriorly by the vertebral fascia. The great vessels and structures of the brachial plexus are intimately adherent to it. At only one point, at its upper posterior portion, is the tumor tissue distinctly outside the gland capsule. Here it has infiltrated the muscular tissue. There is no evidence that the growth extends into the pleura or the mediastinum and nothing in the operative findings indicates the origin of the tumor, unless possibly the fact that the oldest portion of the growth seems to lie behind the angle of the jaw close to the pharynx, which may indicate the tonsils as the primary growth."

#### PATHOLOGICAL STUDY

*Gross.*—Specimen consists of a mass of lymph nodes removed from the left side of the neck. These nodes are bound together into a solid mass about  $11 \times 4$  cm. The mass is fairly firm. On section the mass is seen to consist of discrete nodules closely bound together and these separate nodules are enlarged anywhere from 2 to 8 times their normal size. The predominant tissue in the nodules is fairly firm, slightly translucent, glandularlike tissue, greyish in color. This is dotted with small irregular ochre yellow fat areas of necrosis. In the centre of the mass is a connective tissue growth of white strands of fibrous tissue which radiate out to the periphery of the mass. One small piece of growth taken out has invaded the trapezius muscle for a short distance.

*Microscopic.*—The tumor cell is a large polyhedral cell with eosinophilic cyto-

## SARCOMA OF FEMUR

plasm and a big oval nucleus staining a uniform light blue and containing one or two nucleoli. They are gathered together in rather solid collections in which the tumor cells have quite an irregular arrangement. In some of the collections there is a central area which consists of degenerated cells and fragmental nuclei. The tumor is very much like an epithelioma; there is, however, no sign of cornification (Fig. 3). The vascular supply is good, the stroma is fibrous and delicate in structure, and contains many cells whose nuclei are elongated and dark blue in color.

In one place the tumor is invading striated muscle and has caused atrophy and degeneration of the muscle fibres.

*Diagnosis.*—Branchiogenic epithelioma.

## SARCOMA OF FEMUR

DR. JOHN A. HARTWELL presented a man, aged 18 years, who was admitted to the Cornell Division of Bellevue Hospital in October, 1915, at which time the following history was obtained:

Some time during the spring he had received a slight injury to the right knee, a short time after which a swelling appeared over the internal femoral condyle near its upper extremity. This swelling had gradually increased in size and was quite painful. An examination at that time showed a fluctuating tumor about 2 inches in diameter, involving the soft parts, but there was no apparent bony enlargement. Movements of the knee-joint were slightly restricted because of the tension of the muscles. An aspirating needle withdrew old blood.

The X-ray findings showed a shadow of decreased density in the lower epiphysis and some elevation of the periosteum.

The diagnosis "Periosteal sarcoma" was made and an exploratory operation to confirm this advised.

On opening the tumor a large amount of old blood escaped and the cavity was lined with tumor tissue resembling sarcoma. The periosteum was raised from the bone for a distance of about 3 inches and the cortex over this area was moth-eaten; there was no evidence that the tumor was growing outward from the medulla.

The microscopic examination of the tumor material showed a mixed cell sarcoma. Some of the cells were of the giant type, containing a moderate number of nuclei undergoing division. Other cells were spindle- and round-cells, both small and large.

The patient was advised to undergo X-ray treatment, which he neglected. He returned to the hospital with a very marked recurrence of the condition as shown before. The general condition had deteriorated markedly and he was suffering great pain. He declined further treatment. After 2 weeks he requested to have an amputation done because of the intense suffering.

This was done on January 15, the extremity being removed at the hip-joint by the racket incision, after preliminary closure of the femoral artery through an incision below Poupart's ligament. He made a good recovery, has steadily improved and at the present time, March 16, is in good health.

*Operative Findings.*—After amputation of lower extremity the site of the disease was opened. In the vicinity of the knee-joint and extending upward, to the middle of the thigh, was a fusiform swelling covered with bluish-purple skin. On opening this there was a discharge under pressure of a large quantity of old blood with recent and old clots. The surrounding tissue was markedly œdematous with greenish hue. The periosteum was raised away from the bone for a distance of about 3 inches and in the soft tissue surrounding the elevated periosteum there were spicules and granules of new bone. The process had broken through into the knee-joint which was filled with blood, but there was no actual destruction of the articular cartilage. Dissection of the vessels from the point of amputation well into the growth failed to show any involvement of inner coats.

*Pathological Report.*—Specimen consisted of a leg amputated at the hip. The region just above the knee joint shows a huge spindle shaped swelling. On cutting up the skin and muscles, huge blood clots are exposed just outside the femur, which are a dirty brown in color. The femur on its inside surface is denuded of periosteum, and the bony surface is rough. The bones below the knee-joint are not involved. The femur was sawn through in its sagittal plane. The entire lower end of the bone was filled with a soft, white neoplastic tissue which had destroyed all the cancellous tissue in the centre of the extremity and had eroded the cortex and periosteum through a hole about 1 cm. in diameter situated posteriorly just above the articular surface of the femur. There was considerable hemorrhage in the neoplastic tissue. The cancellous bone near the periphery of the tumor shows less destruction than the bone in the centre. There was one portion of the articular cartilage which was partially eroded by the tumor tissue, which probably gave rise to the effusion of blood into the joint cavity. The growth of the tumor is destructive, but so far had caused no enlargement or deformity of any part of the femur. The shaft of the femur was normal. The upper extremity showed a soft spot the size of a dime in the cancellous tissue. This was red-gray in color.

*Microscopical.*—Section through the tumor involving the cortical layer of bone, showed neoplastic growth composed of several types of cells. The most common variety was a large spindle shaped, polygonal or round cell of abundant eosinophilic cytoplasm, and a round or oval nucleus which took the basophilic stain with varying degrees of intensity. The cells lay closely packed together in a chaotic and irregular arrangement, and almost entirely filled the space between the bone trabeculae. The picture was suggestive of a malignant sarcoma. Besides the mononuclear cells were numerous giant cells which could be roughly divided into two main types. Those in the central portion of the tumor showed



FIG. 1.—Mixed-cell sarcoma from the medullary tissue of the femur, showing giant cells of both the benign and malignant type.

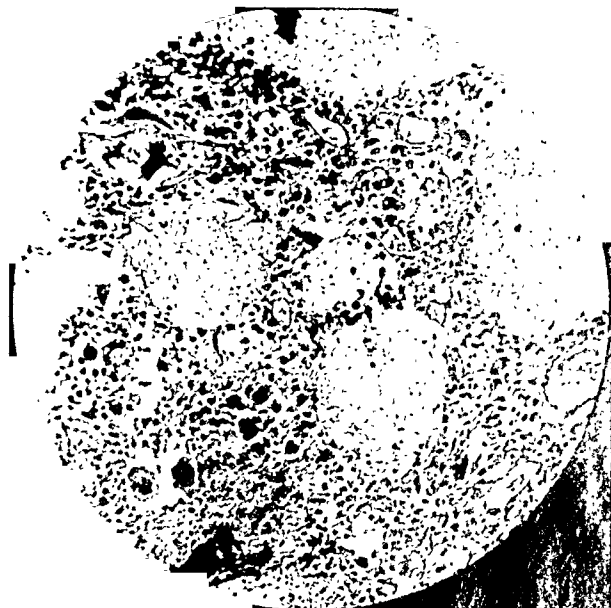


FIG. 2.—High power of a portion of Fig. 1 showing the intimate structure of the two types of giant cells.

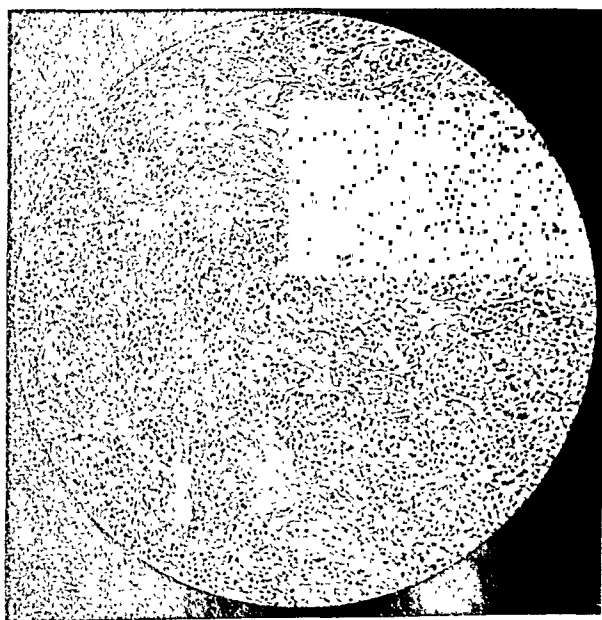


FIG. 3.—Branchiogenic epithelioma showing the squamous type of the cells without cornification.



## SARCOMA OF FEMUR

numerous small nuclei, oval in shape and varying in number from 15 to 40, grouped in the central portion of a huge, irregularly formed, eosinophilic piece of protoplasm. They were like the giant cells found in specimens of epulis. The other giant cells were smaller, irregularly shaped, contained huge round or deformed nuclei about 2 to 5 in number. These were large in proportion to the amount of cytoplasm, and were sometimes arranged so as to form a horseshoe. These were the giant cells so often seen in malignant sarcomata. In this specimen they were found near the cortical portion of the bone, more than elsewhere, but contain only a few red cells. The blood-vessels are distended, and there are a few hemorrhagic areas. The connective tissue is scarce, and for the most part fibrillar. The bone, except in the central portion where it is undergoing lysis by the tumor cells, is normal (Figs. 1 and 2).

*Diagnosis.*—Giant-cell sarcoma of femur.

In presenting this case Dr. Hartwell said that he wished to call attention to certain elements in it which were of great importance.

1. The fact that the X-ray failed to show any involvement of the bone contour which is usually present in sarcoma arising within the medullary cavity. Such growths ordinarily produce an expansion of the cortex of the bone and do not penetrate the structures into the surrounding tissue, so that the X-ray gives a definite fusiform enlargement of the bone.

2. Another point to be emphasized is the fact that most of the tumors arising in the medullary cavity are of the comparatively benign myeloma type with innumerable giant cells, each containing a very large number of small nuclei. Such tumors belong to that class which may be cured by incision and thorough curettage of the bone cavity. This tumor contained many of these, but also contained the malignant type of giant cell with comparatively few nuclei, large in size and division.

The diagnosis of periosteal sarcoma was made in this case because of the failure of the X-ray to show the disease within the bone cortex, and because at operation the growth was immediately beneath the periosteum and did not seem to show any communication with the medullary cavity.

In recent writings, the comparatively non-malignant myeloma has been especially emphasized at the expense of the malignant medullary sarcoma, though the German writers have always recognized the fact that the bone marrow may give rise to both malignant and benign tumors.

It is too early to draw any conclusions as to the ultimate outcome in this patient but there seems to be a fair chance that the tumor will not prove to have the same power of general metastasis which the periosteal sarcoma possesses.

## RESECTION OF PYLORUS FOR ULCER

DR. GEORGE WOOLSEY presented a man, 49 years of age, who was a patient on the Medical Service of Bellevue Hospital for 3 weeks prior to January 6, 1916. His trouble began in July, 1915, by vomiting, 4 to 5 hours after eating, but only in the morning. A month later he noticed pain, mostly in the lower abdomen, which increased and was steady and dull, with occasional attacks of cutting pain. It was not relieved by food but diminished by rest and vomiting. The vomiting continued 3 to 4 times a week. There was no pain after eating. He had anorexia and had lost 25 pounds in 4 months. Wassermann negative. Hæmoglobin, 60 per cent. The X-ray showed "considerable residue to the left of median line 7 hours after ingestion of bismuth. A marked defect on the lesser curvature suggests carcinoma of the pylorus, involving the lesser curvature." This with the appearance of the man and his symptoms led to a provisional diagnosis of gastric cancer. The Ewald meal, however, showed total acid .76, free hydrochloric .42, and no blood. The fractional stomach tests, every 15 minutes, showed hyperacidity.

He refused operation and after his discharge felt quite well; while not working, and gained 8 pounds in 3 weeks. When he began to work the symptoms returned and increased in severity. He had vomiting after eating any food, and constant pain, worse 1 to 2 hours after eating, and relieved by vomiting. He thought he vomited more fluid than he ingested, and noticed no blood in the vomitus. The pain was now principally epigastric and not radiating. Examination of the stomach contents showed hyperacidity and retention of foodstuffs.

Operation, March 6, 16 days ago. Findings: Pyloric end of stomach very adherent posteriorly, especially near the lesser curvature. Two to three inches proximal to the pylorus is a large indurated mass on the posterior surface of the stomach, adherent to the mesocolon and pancreas. The lesser omentum, opposite this area, was much thickened and adherent. There were many enlarged, flattened, soft glands along both curvatures and in front of the pancreas.

As nothing short of resection was indicated, this was done by the Billroth II method. In freeing the stomach from the adherent mesocolon the ulcer was opened, its base being formed by the mesocolon. It was about the size of a dime. A short loop gastrojejunostomy was made with two rows of No. 0 chromic gut sutures, the jejunum being sutured to the anterior surface of the stomach as there was more room here than posteriorly. The stump of the duodenum was sutured to the exposed area of the pancreas. One-third or more of the stomach was

## PERFORATED GASTRIC ULCER-SUTURE

resected. The post-operative course was without incident. Primary union. The patient has already begun to put on weight, though on a rather strict diet. There is no pain or discomfort in the stomach. The X-ray shows that the stomach functionates well.

Owing, probably, to the distance of the ulcer from the pylorus and to early adhesions, this patient never presented the typical symptoms of ulcer, but the atypical continuous symptoms of a complicated ulcer, which quite closely resembled those of carcinoma.

### PERFORATED GASTRIC ULCER-SUTURE. RECURRENCE OF ULCER. GASTRO-ENTEROSTOMY. HEMORRHAGE. TRANSFUSION. GASTROTOMY

DR. WOOLSEY presented a man, 31 years of age, who was admitted to Bellevue Hospital November 1, 1915, in whom, about 17 months before, a perforated gastric ulcer,  $\frac{1}{4}$  inch in diameter and  $1\frac{1}{2}$  inches proximal to the pylorus, on the anterior surface of the stomach, had been closed by suture, without gastro-enterostomy, at the Hudson Street Hospital. He was free of symptoms until about 5 months ago, since when he has had a feeling of heaviness and at times a burning or griping pain in the epigastrium, usually before eating and relieved by food or vomiting. Occasional vomiting occurs about 2 hours after eating and the vomitus is sometimes like coffee-grounds. He has frequently noticed tarry stools, he has lost weight and for the past three weeks his appetite has been poor and the bowels very constipated.

There was marked resistance over the upper right rectus muscle and considerable tenderness over the entire epigastrium. No mass was felt. Ewald test meal gave, amount 600 c.c., total acid .70, free hydrochloric .50, no blood. The X-ray showed a persistent defect in the region of the pylorus, most marked along the lesser curvature, suggestive of ulcer. Also a 6-hour residue.

At operation, November 10, 1915, the pyloric end of the stomach was found quite adherent by bands to the anterior parietal peritoneum and to the lower edge and under surface of the liver. A small hard induration a little proximal to the pylorus was taken to be the scar of the healed ulcer. Posteriorly the pylorus and the first portion of the duodenum were indurated and very adherent to the indurated pancreas behind, presenting an ulcer, probably duodenal. Procedure: After freeing the adhesions a posterior short loop gastrojejunostomy was made with two rows of No. 0 chromic gut sutures. The pylorus was functionally excluded by infolding, by three rows of chromic mattress sutures.



Post-operative course: On the fourth day after operation the temperature dropped to subnormal, he had air hunger, vomited a small amount of new and old blood and soon after had a large black, tarry stool. He was given morphine and proctoclysis. Two days later he felt well and hungry, but was very pale and weak. Hæmoglobin 55 per cent., red cells 1,600,000. There was primary union when the sutures were removed on the sixth day. Seven days after operation he again showed symptoms of hemorrhage and was given morphine, horse serum and hypodermoclysis. He vomited but little and continued to pass tarry stools. Nine days after operation his hæmoglobin was 10 per cent., the blood-pressure was too low to count, he was drowsy and scarcely conscious, so that he was transfused by Dr. Lindeman, who gave 1100 c.c. by his method. When the patient had received 480 c.c. consciousness returned, and after 1100 c.c. he looked and felt like a new man. I operated immediately and opened up the old incision. There were no adhesions or induration about the gastro-enterostomy on the outside. The stomach was opened and the stoma admitted more than two fingers easily and appeared entirely healed. There was no ulcer and no hemorrhage at the site of the anastomosis. The pylorus was narrowed so as not to admit the tip of the finger. The small intestine appeared full of dark clots. The following day there was a slight hemorrhage with the vomiting of a little blood, though a locked suture of chromic gut had been applied around the inner surface of the stoma to prevent the possibility of hemorrhage from this source. There was no further bleeding evident. Convalescence was interrupted by the breaking down of the incision, after union, and the formation of a gastric fistula, which closed spontaneously, after a time, without further operation. In this connection it is to be noted that the inner layer of chromic gut sutures was applied to the wound in the stomach with the edges everted instead of inverted, as I usually do. The breaking down of the incision wound resulted in a ventral hernia. On December 10, 1915, just one month after the first operation, the hæmoglobin was 90 per cent. and the red cells 4,500,000. He has since been operated on for a left inguinal hernia of long standing.

The interesting points in this case are:

First. The recurrence or formation of a posterior duodenal ulcer after suture of a perforated anterior gastric ulcer, without gastro-enterostomy. If gastro-enterostomy had been added it is very probable that the second ulcer would not have formed, another reason for doing it after suture of a perforation, if the patient's condition justifies it.

## MUCOUS MEMBRANE PLASTIC AFTER REMOVAL OF EPULIS

There was a moderate degree of pyloric stenosis following the suture and healing of the ulcer.

Second. The life-saving result of the direct transfusion of blood. I have seen this in several other gastric cases.

Third. The hemorrhage evidently came from the ulcer and not from the gastro-enterostomy. The greater part of the blood was passed by the bowel, the relatively small amount that was vomited entered the stomach either through the imperfectly occluded pylorus or through the stoma or through both. This case is another example of the fact, which von Eiselsberg emphasized in his paper in London in 1914, that neither gastro-enterostomy nor pyloric exclusion will surely prevent hemorrhage from an ulcer, but may even provoke it.

DR. FRANK S. MATHEWS said that recently he attempted to excise a large ulcer that had perforated into the pancreas and attempted a suture without doing a transgastric resection. After partial suture, he found that this method would pretty surely close the pylorus almost completely. It seemed to him that in similar cases, it would be wiser to begin the operation with transgastric resection in mind rather than excision. The excision will surely result in a much deformed stomach.

Referring to the second case, he had performed four anterior gastro-enterostomies within recent months. Some were for carcinoma where resection was done and others where the disease was too extensive for excision. In each case, the loop of small intestine, taken at some little distance from the duodeno-jejunal junction, had been brought up in front of the transverse colon but without compressing it. Before closing the circle of sutures in the gastro-enterostomy, he had loosened the clamp on the jejunum and dropped a half of a Murphy button into the oral and aboral segment of the gut. After concluding the gastro-enterostomy, an entero-anastomosis was made by snapping together the halves of the Murphy button after making a cut a half inch long in the wall of the gut. This procedure adds but a couple of minutes to the length of the operation and avoids the possibility of vicious circle from duodenal distention. He was not advising anterior gastro-enterostomy as preferable to posterior gastro-enterostomy but simply suggests its use where the posterior wall is either involved in the disease or difficult to get at.

## MUCOUS MEMBRANE PLASTIC AFTER REMOVAL OF EPULIS

DR. JOHN DOUGLAS presented a boy 16 years old, from whom an epulis had been removed 5 months ago. The tumor had been present for 3 years, was slowly increasing in size, was about 1.5 cm. in diameter,

and was situated just below the roots of the left lower lateral incisor and canine teeth. It was hard in consistency and pale in color and evidently of a benign nature.

Its removal together with the underlying periosteum, laid bare the bone and destroyed the normal gingival tissue covering the roots of these teeth. To protect the teeth a flap of mucous membrane with the submucous tissue was dissected from the lower lip. The broad base of the flap was downward where the lip joins the gum, its apex about 1.5 cm. wide just inside the vermilion border of the lip. This flap was swung around and sutured into the defect caused by the removal of the epulis, its apex being fastened by a silk suture passed through each corner and tied around the teeth. The mucous membrane was easily brought together to close the defect on the inner surface of the lower lip, caused by the removal of the flap.

The present condition of the patient, 5 months after the operation, shows almost no retraction of the flap, which has shrunken down over the roots of the teeth so as to look almost like normal gum tissue.

#### VENTRAL HERNIA

DR. ALEXIS V. MOSCHCOWITZ presented a woman, now twenty-six years of age, who was admitted to Mount Sinai Hospital November 4, 1912, with the diagnosis of acute intestinal obstruction. A more definite diagnosis could not be made; but the few existing physical signs led to the belief that the seat of the obstruction was located in the left half of the transverse colon. On exploration there was found a perfect example of that type of intestinal obstruction, fully described by Payr, namely, of dense adhesions between the left half of the transverse colon and upper half of the descending colon, with involvement of the splenic flexure; the descending colon was completely collapsed; while the proximal part of the transverse colon and the ascending colon were distended. In order to obtain proper exposure he added a transverse incision, so that the incision finally resembled an L. The adhesions were separated with considerable difficulty, but when finally accomplished gas passed freely into the descending colon and sigmoid flexure. Perfect primary union was obtained throughout the incision. Patient was discharged November 18, 1912.

At the present time (approximately three and one-half years after operation) the transverse part of the incision is healed perfectly solid, but the vertical part of the incision has dilated and in fact is the seat of a ventral hernia. He presented this case as a further argument in favor of transverse incisions.

## TUMOR WITHIN LUMEN OF SMALL INTESTINE

### ORTHOSTATIC ALBUMINURIA

DR. MOSCHCOWITZ presented a woman, forty years of age, who was referred to him about a month ago for operation for ventral hernia, the result of an operation for acute gangrenous appendicitis with abscess, and which took place September 15, 1914. The preliminary examination revealed, in addition to extreme adiposity, a huge ventral hernia, with adherent contents, and a hernial ring approximately five inches in diameter. The urine was so loaded with albumin that it practically boiled solid. Her blood-pressure was very high for her age, namely, one hundred and seventy. He informed her family physician of these facts, and declined operation temporarily. Her physician, a very careful man, was rather surprised at this decision, because he had examined the urine of the patient only a short while before, and found it to be normal; on the following morning he again examined it, and, much to the reporter's surprise, he again found it to be normal.

Finally he consented to operate and the patient was admitted to the Har Moriah Hospital, where it was found that the urine was again loaded with albumin; on rest in bed the albumin disappeared until merely a trace was found. When, however, the patient was allowed to be up and about again large amounts of albumin were found. The functional capacity was tested with phthalein, and was found to be normal.

He referred this case to the indefinite group of orthostatic albuminuria, and presented it particularly in order to obtain an expression of opinion as regards the indication for operation. The following points are to be particularly emphasized: 1. The presence of large amounts of albumin in the urine. 2. The variability in the amount of the albumin. 3. The high blood-pressure. 4. The adiposity of the patient. 5. The size of the hernia.

### ACUTE INTUSSUSCEPTION (ENTERO-ENTERIC) DUE TO TUMOR WITHIN THE LUMEN OF THE SMALL INTESTINE

DR. L. W. HOTCHKISS presented a man, 19 years of age, who was admitted to Bellevue Hospital in September, 1915, suffering with severe pain in the lower abdomen which had begun about an hour before. At that time he was seized with severe abdominal cramps which came on at irregular intervals lasting two or three minutes, then subsiding, leaving a dull ache. Vomiting began shortly after the beginning of the seizure and continued. There had been a bowel movement on the day before. The patient gave a history of numerous similar attacks, although not so severe and lasting from one hour to a day and then subsiding. He generally vomits in the attacks, is constipated and has been relieved heretofore by catharsis.

Physical examination reveals a fairly well nourished but very pale young man. Heart sounds: Loud blowing murmur at the apex. Lungs negative. Abdomen rigid in lower half which is fuller than the upper half, especially upon the right side. There are no masses felt, nor any visible peristalsis noted. Rectus muscle becomes rigid on pressure and deep palpation brings on new attack of pain. White blood-cells, 7000; 75 per cent. polymorphonuclears. Urine negative.

After opening the abdomen the appendix was found to be apparently not inflamed, but there were some fibrous bands about the cæcum and adhesions.

December 12. The patient was awakened early this morning with such intense abdominal pain that he roused the whole ward with his yells. Enemas had no effect, and, the pain continuing, he was transferred to the surgical ward under my care and prepared for immediate operation, as acute intestinal obstruction was evident.

Operation, December 12, 11 A.M. As the lower half of the abdomen was distended and rather more so upon the left than upon the right side, a median laparotomy below the umbilicus was made and the cause of the obstruction sought. There was an escape of slightly blood-stained serum as soon as the peritoneum was opened, and a rapid search revealed a large mass in the lower abdomen which, being delivered into the wound, was found to consist of a loop of enormously distended small intestine which extended in a generally transverse direction across the lower abdomen. There was a distinct axial twist of the mesentery, which was unwound and the tumor found to consist of an intussusception of the small intestine, the intussusception being so tightly grasped that reduction by pressure was not to be effected. As the invagination had been of so short duration traction was made and the intussusception reduced, by a rather sharp jerk on the gut below the constriction. With the reduction of the last portion of the gut the cause of the obstruction became evident, as a tumor within the lumen of the portion of invaginated gut could easily be felt, and as this growth evidently pretty nearly obstructed its lumen a portion of the gut containing the tumor was resected and the ends of the gut were sutured together by end-to-end anastomosis.

The condition of the intussusceptum was good and with the exception of a few strings of fibrin upon the outer coat it showed no change as a result of the invagination. Wound closed and healing promptly occurred between the somewhat elongated appendix and the cæcum. The appendix was removed and the wound closed. The convalescence was interrupted by a severe attack of colic about the third day, but otherwise the patient progressed favorably and the wound healed per primam.

## TUMOR WITHIN LUMEN OF SMALL INTESTINE

After remaining out about a month, the patient was readmitted on November 12, complaining of weakness, loss of strength in the lower limbs, and indigestion. After leaving the hospital he had resumed his work as clerk in an office and had remained four weeks, but finding himself growing rapidly weaker and unable to keep up with his work had come back to the hospital for treatment.

He has had palpitation and dizzy spells, occasional attacks of abdominal pain and eructations of gas, and sometimes nausea. Physical examination shows marked anæmia. Heart shows murmur as before described. Urine shows a faint trace of albumin. Abdomen soft, negative. White blood-cells, 8400; polymorphonuclears, 56 per cent.; lymphocytes, 18 per cent.; eosinophiles, 0 per cent.; red blood-cells, 3,592,000; hæmoglobin, 30 per cent. He was transferred to the medical division for treatment, November 16. On November 30 occult blood was discovered in the stools.

December 2. Gastric analysis practically negative. Free hydrochloric, 60 per cent. Total acidity, 105. Combined, 45. Blood positive, probably from tube.

X-ray examination on December 8, according to the radiologist, showed extensive periduodenal adhesions and fixation of pars pylorica and duodenum and hepatic flexure of the colon. Positive X-ray diagnosis of duodenal ulcer.

December 9. First seen by Dr. Hotchkiss in consultation with Dr. Norrie, as to the question of probable duodenal ulcer. Lenhardt diet ordered, as diagnosis seemed too doubtful to operate.

*Post-operative Course.*—The patient rapidly gained in flesh and strength and by January 7 his hæmoglobin had increased to 70 per cent., and he has had no further abdominal pain. He was discharged about three weeks later in good condition, able to enjoy the regular diet without discomfort and gaining weight steadily.

*Pathologist's Report on Tumor.*—Specimen examined consists of a piece of gut 60 mm. in diameter and 90 mm. in breadth. The valvulæ conniventes are fairly well marked. In centre of specimen there is a pedunculated tumor mass with a rather broad pedicle measuring transversely 33.3 cm. It thus occluded almost entirely the lumen of the small intestine. The serosa opposite the pedicle is thickened and the tissue is retracted through scar formation. Microscopically it is a typical adenomatous polyp. There is no evidence of malignancy.

This case is reported as a rare form of intussusception and it suggests at least a possible source of occult blood in the stools, also, perhaps, a possible cause of some cases of unexplained anæmias.

# TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY

*Stated Meeting, held April 3, 1916*

The President, DR. CHARLES H. FRAZIER, in the Chair

## SUBACROMIAL BURSTITIS, SHOWING RECOVERY FROM OPERATION

DR. JAMES K. YOUNG exhibited a man, aged thirty-five years, referred to him by Dr. Thomas A. Erck, on account of a painful condition of the shoulder-joint. Eight months before the man had a fall from a height of 26 feet, and caught on something with his right hand, injuring the shoulder; since that time there has been noted severe pain in the shoulder-joint, especially beneath the deltoid muscle.

Examination showed considerable disability of the shoulder-joint, with inability to lift the arm shoulder high. The X-ray showed a shadow due apparently to a localized infiltration of the soft parts just below the tip of the acromion process on the right side. A diagnosis of subacromion bursitis was made, and the Codman operation was performed by him, following the technic accurately. An incision was made on point of shoulder about  $2\frac{1}{2}$  inches in length, extending down to but not beyond the centre of the deltoid, at which point the circumflex nerve winds around the neck of the humerus. The fibres of the deltoid were separated, the bursa was exposed and found to be adherent to the muscle, these bands were separated, the sac was opened and a white fluid evacuated; there was no calcification of the sac and no loose fragments of bone; there was one firm band of adhesion in the upper part of the sac which was divided. No deep sutures were used and the wound was closed with silk gut sutures. The arm was elevated to a right angle and suspended in bed for forty-eight hours; primary union occurred; four weeks later the arm was manipulated and massaged, and perfect recovery resulted.

The interesting features of this case were: (1) Prolonged and ineffectual treatment which he had for eight months before applying for operation; (2) the possibility of making a diagnosis from the X-ray in a bursa in which there was no calcification; (3) the simple character of and prompt recovery from the operation.

There are many such cases in every large orthopædic clinic, some are

## SUBACROMIAL BURSITIS

simple without injury to the bone, and in some which he operated upon recently, there were fragments of bone lying beneath the bursa, which required attention after the bursa had been opened. It has been said that manipulation is more important in these patients than operation, but in this particular individual the operation seems to have been more important than the manipulation itself. It has also been stated that these patients recover within a given space of time without any operation, but in this particular individual there was no improvement whatever eight months after the accident and he was totally incapacitated for work. It has been a question whether time is shortened by operation, and it appears in this patient that the time was distinctly shortened by the operation.

DR. GWILYM G. DAVIS said that Dr. Young's case of subacromial bursitis brought up the question of the advisability of operating in cases of disability in which restriction of motion of the shoulder-joint is present. He thought the disability to be due to the normal motion being restricted by effusion or contraction or by bands; and, if by some means the causes which limit the motion are eliminated, there will ensue a return of function. That being so, if these cases were treated by some method of persistent stretching, by some form of exercise, by free movement of the joint under anæsthetization; or, if the patients were put in bed and weight traction made to increase abduction, or by any means to obtain a normal range of motion, the symptoms will be eliminated. In these cases of disability the question arises as to whether or not the improvement is due to the operation itself. He was inclined to believe that the improvement is not due to the cutting part of the operation, but to the improved position in which the limb is placed after the operation is completed; in other words, to the freer motion and the placing of the arm during the process of healing in the most extreme position. If this be true, then the same result ought to be brought about by persistent conservative methods which will stretch the adhesions; or by radical movements under an anæsthetic, which will rupture or stretch adhesions and increase the range of motion, this to be followed by exercise of the parts.

DR. A. P. C. ASHHURST said that he saw a great many stiff and painful shoulders, but it is impossible to secure hospital accommodations enough to operate on even a small proportion of them. He never saw but one patient that he thought he could certainly diagnose as a subacromial bursitis without other lesion, yet at operation on this patient, no bursa at all was present, but under the thinned deltoid he did find inside the capsule two osteophytes, which he removed; and the patient's



disability was completely relieved (ANNALS OF SURGERY, 1916, I, 174). If one could treat these patients with periarthrits of the shoulder in the manner Dr. Davis suggests, without operation but by persistent abduction in a plaster case, retained for from four to eight weeks, one might be able to cure them; but it is difficult to induce an adult patient to have his arm fixed so long in this position. Operative treatment, therefore, is not entirely to be condemned if it will get a patient well in a shorter time. He asked Dr. Young how long he kept the patient in bed, whether the time of treatment was lengthened or shortened by operation, and whether, if he had given an anæsthetic and instituted abduction and done no operation, he would not have kept the patient in bed the same length of time.

DR. DAMON B. PFEIFFER had been trying for some time to get some information regarding stiff and painful shoulders. He had been impressed with the uncertainty in the etiology of stiff and painful shoulders and with the lack of a definite underlying pathology. Dr. Ashhurst's case of a spur of bone which seemed to be the cause of disability reminded him of a case on which he operated about six months ago: a man fell into a hole, receiving an injury to the shoulder-joint; following the injury he had a very rigid shoulder, the arm could not be abducted to a right angle, and was almost without power. The man was under observation for two months, the X-ray showing absolutely nothing, but the patient's condition nevertheless demanded relief. There was a peculiar grating in the shoulder on motion which he attributed to sub-acromial bursitis. Making the usual incision, he found a small triangular gap in the capsule of the joint, evidently due to a rupture at the time of the accident. At the base of the triangle there was a rough protruding ridge of bone from which the capsule had been torn, and this gave the grating sensation by infringing upon the acromion. He attempted to close the defect, first chiselling away the bone and making it smooth, but was unable to do this because the tissue was detracted and dense. He then mobilized the capsule by undermining it and shifted it across in order to close the defect. A plaster dressing was applied and the arm kept in hyperabduction for four weeks. The arm was much improved when he left the hospital, but he had not been seen since. These cases emphasize the uncertainty of the underlying pathology prior to operation and the fact that here, as in the abdomen, the exploratory incision is justified in certain cases.

DR. T. TURNER THOMAS had seen the same condition described by Dr. Pfeiffer of a perforation in the joint capsule and overlying rotator tendons. It would seem to be due to the tearing away of the capsule

## TOXIC GOITRE

and the overlying tendons from the greater tuberosity to which they are attached. He thought the tearing away of the capsule with the fragments of bone gives the calcification that we hear so much about in connection with subacromial bursitis.

### TUBERCULOUS AND LUETIC INFECTION OF KNEE-JOINT

DR. JAMES K. YOUNG also reported a case of a youth fourteen years old suffering from mixed infection of the knee-joint—tuberculous and luetic. Three months before he first saw him he fell, striking his right knee, and acute inflammation and swelling occurred, and two weeks later he was taken to a large general hospital where he remained three weeks. He left the hospital because amputation was advised.

Examination at this time showed the right knee greatly enlarged, indurated and flexed to 10 degrees; the joint could be flexed but could not be extended. The family history was negative. The X-ray showed a large amount of periosteal inflammation with some enlargement of the bone; the disease did not extend into the cartilage of the knee-joint. The tuberculin test was positive and the Wassermann test was slightly positive. The limb was straightened by dividing the hamstring tendons and forcible correction under an anæsthetic. Subsequent to this operation an abscess formed and a sequestrum was removed. Later a circular seat brace was used to take the weight off the joint, and the limb was kept in an extended position. In addition to the mixed treatment he was given local applications of the X-ray. The result has been most gratifying, there is a complete restoration of all the movements of the joint and entire freedom from pain. The interesting feature of this case was the diagnosis which was confirmed by the Röntgen examination. The pathological condition present has to be distinguished from sarcoma. There was marked periosteal thickening in the negative taken four months after the onset of the disease, the striated appearance being characteristic of specific disease.

Specific osteomyelitis shows more sclerosis and less infiltrating destruction of the bone than occurs in acute pyogenic osteomyelitis.

In sarcoma the ossification progresses in an irregular and ragged way, the effect in the X-ray being not uniform but spotted quite different from the regular bony layers observed in chronic specific periosteitis. The exudate has a smoky appearance.

### TOXIC GOITRE IN GIRL TEN YEARS OLD

DR. A. W. SAWYER, by invitation, described the case of a girl, ten years of age, who was admitted to Dr. Frazier's service, University

Hospital, March 8, 1916, with a complaint of goitre and nervousness. She is a school-girl, ordinarily industrious and does well in her studies. She sleeps well, but gets easily tired and excited. She has had measles, mumps, pertussis and scarlet fever. She is subject to colds. Menstrual periods have not begun.

Father is an alcoholic and on many occasions had returned home in a drunken condition threatening to either turn the family out into the street or kill them all. Naturally, this has always greatly upset the child, and may be a possible etiological factor in her case. At present the father is suffering from tuberculosis at Mt. Alto, so that disturbing element in the family life is eliminated. The mother, four sisters and one brother are living and well. Two brothers are dead, one dying at birth, the other in infancy of unknown cause. Two aunts died of cancer of the breast and one of toxic goitre.

With reference to the present history, two years ago, patient developed shortness of breath upon exertion, and attacks of palpitation of the heart. At this time a swelling was noticed in the neck. Nervousness came on shortly after and dyspnoea, and palpitation gradually increased. For the past year and a half she has had pain about the heart which becomes marked upon exertion. This is not always severe, but it is discomforting. At times she is cyanotic upon exertion and for the past two years has had night sweats and becomes easily excited.

There is no cough or other symptom referable to the lungs. Appetite is poor and at times she suffers from indigestion. No vomiting. Bowels are regular. No difficulty in breathing or swallowing. No swelling of the ankles. Former headaches have been relieved by glasses. Mother stated that child was unusually thin and had no desire to work or play.

She was a thin, rather poorly nourished young girl, with flushed cheeks and watery eyes. Pupils were slightly dilated. They reacted to light and accommodation, there was no widening of the palpebral fissure, no exophthalmos or von Graefe sign. Voice was husky. Laryngoscopic examination was negative. Upon admission pulse ranged between 90 and 105.

Thyroid gland is moderately enlarged. Both lobes about equal. There was an expansile pulsation felt over the gland, also a slight thrill, and at times a bruit was heard. There was slight enlargement of the posterior cervical lymphatics. There was a marked systolic pulsation in the vessels of the neck and in the episternal notch, and a systolic murmur was heard in the carotids.

The chest was thin, lungs normal, except for the right apex, which

## TOXIC GOITRE

showed increased harshness of the breath sound both anteriorly and posteriorly with slight increase of vocal resonance. No whispered voice sounds or râles were heard.

Heart was slightly enlarged both to the right and left, muscular quality good. Rate was somewhat rapid and there was a marked respiratory arrhythmia. At the apex there was a soft systolic murmur and a harsh systolic murmur at the aortic area transmitted to the vessels of the neck.

Abdomen negative. Hands and feet were sweaty. There was no tremor and no cedema of the ankles. Reflexes normal.

With the exception of a slight trace of albumin, urine was negative.

Blood showed 18 per cent. of lymphocytes in the differential. Blood-pressure, systolic 114, diastolic, 48.

Fluoroscopic examination of the chest revealed no substernal thyroid or thymus. She was put to bed at once on routine anoci treatment in preparation for operation, which was performed twelve days later. During this time she improved but slightly.

Operation was performed by Dr. Frazier under anoci technic. Both lobes were found to be enlarged, but because of the child's age, it was thought wise to do only a single lobectomy. The right was removed, together with the isthmus as far as the left side of the trachea, leaving the posterior capsule behind. Wound was closed with drainage which was removed in twenty-four hours, stitches were taken out in seven days, wound healing by first intention.

Patient is making an uneventful recovery with gradual improvement in the symptoms. She feels better, is not so nervous and does not flush up as easily. Heart rate is about the same, although the chart shows that it has not reached the high points that it did previous to operation.

Blood-pressure, systolic, 108; diastolic, 68.

The signs which were present in the heart before operation have disappeared so that there are now no abnormalities. Electric cardiograph tracings made both before and after operation show a change in the temperature wave which might perhaps be taken to mean that the ventricular action of the heart is somewhat lessened. Blood picture is approximately the same as on admission.

Pathological report gives a diagnosis of colloid and exophthalmic goitre, the toxic hyperplasia being secondary.

Except as to the age of the patient the case was not an unusual one, but because it was the youngest case of goitre with which they had had to deal it was deemed worthy of note. Dr. Frazier has had one case of sarcoma of the thyroid in a boy of eleven years, and he recently saw a

girl of twelve years who had a non-toxic goitre of several months standing. In this case there was also an etiology of a drunken parent upsetting the nervous mechanism of the child.

The reporter referred to an article by Dr. Coleman Buford, of Chicago, in which he speaks of the condition as rather common. To be sure, Chicago is in a goitrous territory, and therefore many more goitres of all ages are seen.

Dr. Buford divides the cases into three groups: (1) Those of infancy under one year of age; (2) those of childhood from one year to adolescence; (3) those of adolescence.

In the first group, namely those under one year of age, he finds that they are not so frequent. He cites a case of an infant under one year at the Cook County Hospital, who had a goitre but this was accompanied by an enlarged thymus. Reference is also made to a case of goitre in a 6-months' foetus, and he says that there are other scattered references through the literature of goitre in infants under one year. No reference was found in the pathological records of late years. Dr. Joseph B. DeLee has seen goitre present at birth, one in an infant born of a goitrous mother, in which the goitre was so large that the child's head was forced backward because of it. He says it is not uncommon for goitres to appear in children the second or third day after birth, and then in a few days to quickly disappear.

In the second group, namely from one year to adolescence, to which this case belongs, goitres occur with increasing frequency, according to Dr. Buford, and between six years and adolescence they are very numerous, at least in the region about Chicago.

They are usually goitres involving a well-defined area of the gland, and 9 out of every 10 will show the lesion in the lower pole of the right lobe. From this Dr. Buford assumes that possibly the thyroid gland has a division of function. They are usually benign adenomas with varying degrees of toxicity. Some are very toxic. Unilateral thyroidectomy is not often indicated. Usually, removing the encapsulated nodule or mass is sufficient, while the majority are benefited and relieved from symptoms by thyroid feeding, removal of focal infections, such as badly diseased tonsils, adenoids and teeth, and proper hygiene. He finds goitres often associated with diseased tonsils; the sort that look innocent enough until the pillar is pulled aside and the tonsil turned out of its bed.

The symptom-complex which he gives indicates a low grade of health and the case just recited falls under this list very readily. The children, mostly girls, are frail and thin with soft muscles

## PERFORATING STOMA

which easily fatigue. They are irritable, do not enjoy play and are slow in school. The eyes are usually bright and watery. No exophthalmos. Hair is gritty and dry. There is a faint flush of the cheeks, complexion is muddy and skin frequently shows eruptions. Extremities are cold and the pulse ranges between 80 and 120. The heart is tumultuous but shows no tachycardia in the usual sense. Occasionally fine tremors of the choreiform type are present.

No characteristic blood picture and no chlorosis. The history of this ten-year-old patient fits into this syndrome very well.

Out of about 3000 cases of goitre in the Mayo Clinic, 10 per cent. were under twenty years of age and only *five cases* were below ten years. The youngest was four, who showed a typical exophthalmic type. There were 3 cases of seven years, and one of eight. All were girls.

### PERFORATION AT THE STOMA TWO YEARS AFTER A GASTRO-JEJUNOSTOMY FOR DUODENAL ULCER

DRS. GEORGE G. ROSS and WILLIAM B. SWARTLEY reported the case of a man, thirty-three years of age, who was admitted to the Germantown Dispensary and Hospital, November 3, 1912, and discharged December 12, 1912, as improved. He presented the symptoms of duodenal ulcer, and was so greatly improved by dietetic treatment that he was discharged after five weeks.

He was readmitted to the surgical ward of the Germantown Dispensary and Hospital, January 27, 1913, in the service of Dr. G. H. Ross, stating that two weeks after discharge from the hospital his previous symptoms began to recur with increased severity. He treated himself as before in order to get relief, but the symptoms were so extreme that he returned to the hospital.

*Operation* (January 29, 1913).—The peritoneal cavity was opened by an upper right rectus incision, and an ulcer found on the duodenal side of the pylorus. A posterior gastrojejunostomy was performed and the pylorus was plicated and the abdomen closed in the usual manner. Patient had a satisfactory recovery from this operation and was discharged as cured on February 21, 1913.

He was again readmitted to the surgical ward of the Germantown Dispensary and Hospital on the service of Dr. Francis T. Stewart, April 28, 1915, with the following history: Three weeks after his second discharge from the hospital, he noticed a burning persistent pain in his lower abdomen just above the pubis. Diet and "Sprudel salts" gave relief. He would have a period of malaise, nausea and vomiting almost every month. The pain would often come on about one-half

to one hour after a heavy meal, and as a rule was accompanied by pain shooting to both shoulders. Most often he had a gnawing and burning pain on an empty stomach, most pronounced about 5 P.M. These symptoms continued; always has gas and an oily fatty taste upon belching and a great deal of "heart-burn." In the morning of April 28, 1915, he did not feel well and ate nothing, but took a dose of salts with temporary improvement. He carried a bucket of coal from the cellar and on his arrival upstairs he had a sudden, sharp, stabbing and cramp-like pain in his upper abdomen, most severe around the umbilicus, and soon becoming general. This pain was accompanied by cold sweats. The physician who saw him then said he had board-like rigidity of the entire abdomen and was greatly shocked. He did not vomit, but was nauseated. His bowels had been regular and three weeks before admission they were a tarry black color. When admitted the abdomen was somewhat distended and absolutely quiescent. Respiration was entirely thoracic. The abdominal muscles were in a condition of tonic rigidity. The entire abdomen was tender, but tenderness was most marked in the lower abdomen and at a point one and a half inches to the left and on a level with the umbilicus. This point was the location of the original pain. Some dulness in the flanks upon percussion but mostly in the left side. No audible peristalsis. Four or five hours after the initial pain, the abdomen was opened by an incision 2 cm. to the left and parallel to the previous incision. The belly wall was very thin. There were many adhesions to the old scar of the previous operation. On opening the peritoneal cavity, gas and free seropurulent fluid escaped. The adhesions to the old scar of the previous operation were so dense that examination to the right of the incision was impossible. The transverse colon appeared under the incision. This and the small gut were greatly inflamed. Search revealed a perforation to be on the jejunal side of the anastomosis and just at the point of anastomosis. The perforation was about 8 to 9 mm. in diameter and of a typical punched-out type. There was no suture material found at the site of the perforation. The perforation was invaginated with a purse-string suture of linen thread. A second suture of linen thread was used to reinforce and cover over the perforated area. A counter opening was made in the midline, midway between the umbilicus and the pubis, and a large rubber tube was inserted into the pelvis for drainage. Seropurulent fluid escaped from the pelvis. The wound was closed by layer suture and four tension sutures. One long piece of gauze drainage was allowed to remain at the lower end of the upper incision. The abdominal cavity was not flushed out with salt solution. Patient was placed in

## PERFORATING STOMA

the Fowler position and given proctoclysis. He was given nothing by mouth until the fifth day, when he had a few fluid drachms of albumin water. This was increased until he was given liquid diet without milk and soft diet on the tenth day. The rubber drainage tube in the pelvis was removed on the fourth day, while the gauze drainage in the upper incision was entirely removed on the seventh day after operation. All stitches were removed on the tenth day and the patient allowed out of bed in a wheel chair. The highest temperature was 102° F. on the day after operation. The temperature gradually returned to normal and remained so until the fifteenth day, when it rose to 101 4/5°. This temperature was reactionary, after shock due to a profuse hemorrhage from the bowel and stomach. After the bowel movement, which consisted almost entirely of blood, the patient fainted and was put back to bed, having all the symptoms of shock. After being returned to bed, he began vomiting large quantities of fresh blood. The bleeding was so severe that adrenalin chloride (1 to 1000) in two fluidrachms of water was given by mouth and morphine sulphate, gr. 1/6, by hypodermic. The vomiting of blood decreased gradually and after three days they again began to give patient water in small quantities by mouth and peptonized milk by rectum. On the eighteenth day after operation he was again given liquids, and on the nineteenth day allowed out of bed with no recurrence of complications. He was discharged as greatly improved on June 11, 1915. Since patient has returned to his home, he has been working regularly and has had very little pain in the stomach. After eating a big meal or after eating fried foods, he has had discomfort and vomited several times, but is now feeling better and has gained weight. Ten days after his discharge from the hospital the patient was married, and is now the happy father of twins.

Statistics show that jejunal ulceration occurs in 1.5 per cent. of all gastro-enterostomies. Keen states that all of these cases were of the perforating character, and therefore were not recognized, causing death by abscess, or in other ways in which adhesions and complications so obscured the parts that even an autopsy failed to reveal the true nature of the disease. Mikulicz says that in 34 instances in which the location of the gastro-enterostomy anastomosis was mentioned, it occurred 25 times by the anterior and 6 times by the posterior method. In the posterior operations the jejunal opening is about 9 inches distant from the beginning of the jejunum; in the anterior it is from 16 to 20 inches distant from this point. It would appear, therefore, that the lower the point of anastomosis in the jejunum, the more susceptible the mucosa to digestive action of the peptic juices.



## PHILADELPHIA ACADEMY OF SURGERY

The jejunal ulcer develops most frequently within the first six months following the original gastro-enterostomy. Of the 146 cases collected by Schwarz in 1914, 50 developed within this period, 22 within the second half of the year, 20 between the second and fifth years, and 13 between the fifth and tenth years. As a rule, the ulcer lies close to, and is exactly on the line of, the anastomosis, but sometimes it may be an inch or two away in the bowel, at either side of the anastomosis.

In 58 cases Van Roojen found the position to be:

In the closest proximity to, or exactly upon, the suture line in....	42
In the proximal limb of the jejunum in.....	6
In the distal limb of the jejunum in.....	8
In or near the point of an entero-anastomosis in.....	2

## AMŒBIC ABSCESS OF THE LIVER

DR. A. C. WOOD had a paper with the above title, for which see page 335.

## MESENTERIC THROMBOSIS

DR. GEORGE M. LAWS reported the case of a boy of ten years, who on January 1, 1915, was seized with acute abdominal pain soon followed by vomiting. He was taken home on a train by his mother and during the hour's ride went into collapse. A course of calomel was administered and followed by the passage of a large quantity of blood. A few hours later there were two small bloody stools. He continued to have severe colicky pains and vomiting and showed the effect of hemorrhage when seen by the reporter, four days after the onset, with Dr. H. L. Sinexon of Paulsboro, N. J. At that time the abdomen was moderately distended and decidedly rigid and tender, especially below and to the right of the navel. Peristalsis was increased. Rectal palpation revealed nothing except the presence of old blood. No attempt had been made to move the bowels since the first day. The patient had a tuberculous history and had never been robust. For several years he had often complained of abdominal pain in the early morning, for which no cause could be discovered. Three months before this attack he had swallowed a penny which was never found, but gave rise to no apparent trouble. He was removed at once to the University Hospital. On admission blood examination was: red blood-cells, 3,350,000; white blood-cells, 17,600; hæmoglobin 46 per cent.; differential polymorphonuclears, 86 per cent.; lymphocytes, 11 per cent.; leucocytes, mononuclear, transitionals 1 per cent.; temperature, 99. Pulse, 107. Respirations, 32.

## STREPTOCOCCIC PERITONITIS COMPLICATING ERYSIPELAS

Dr. Laws, with the assistance and counsel of Dr. J. B. Carnett, opened the abdomen by a right rectus incision; a considerable quantity of bloody fluid poured out of the peritoneal cavity. About two feet of the small intestines presented, distended, œdematous and purplish in color. The line of demarcation was fairly well defined at both ends. Delivery of the loop seemed to straighten out an obstructing kink at the distal end which, however, was regarded as secondary rather than the cause of the trouble. Below this point the intestine was collapsed. The mesentery was studded throughout with hard lymph-nodes of various size, evidently tuberculous. The mesenteric veins corresponding to the damaged segment were thrombosed. It was decided not to resect because of the well-known high mortality, the technical difficulties presented by the condition of the mesentery, and the fact that the gut was still viable after four days, and the patient had not grown progressively worse. The appendix was normal and was not removed. The wound was closed without drainage. The boy was very ill for two days. Vomiting then ceased and distention gradually subsided. After recovery he improved decidedly in general health and has had no return of the former abdominal pain, which was probably due to the *tabes mesenterica* and may have been benefited by exploratory laparotomy and subsequent treatment.

## STREPTOCOCCIC PERITONITIS COMPLICATING ERYSIPELAS

DR. LAWS related the case of a man, aged nineteen years, who was admitted to the Phila. General Hospital, service of Dr. A. C. Wood, Feb. 19, 1916, with the following history. After a prodromal period of four days the patient developed a rapidly spreading facial erysipelas on February 16. At its height the temperature was 101° F.; the pulse 90. The duration was short and by the third day was rapidly subsiding. During the evening of February 17 he had slight pain over the splenic area, but did not call attention to it until the following morning, when it became worse. Abdominal examination was negative and an ice-bag was applied and the pain relieved. In the evening of the eighteenth he complained of pain in the region of the appendix. There was slight tenderness but no rigidity. Temperature 99; pulse 88. The next morning he began to vomit and had slight abdominal rigidity. Temperature normal; pulse 100. At 4 P.M. he had grown worse—temperature 97°, pulse 120, pain most marked over appendix. He was then sent to the hospital with a diagnosis of appendicitis. By evening he had general abdominal rigidity, tenderness and distention. Peristalsis was absent. Examination of the chest disclosed a pleural friction

at the left base and evidence of an inactive tuberculous process at the apex. Under the diagnosis of perforative peritonitis the abdomen was opened by a right rectus incision; free fluid, turbid and flaky, escaped. The appendix was partly covered with inflammatory lymph and was removed. It was not perforated and the fluid was odorless. A large quantity of fluid was present in the pelvis and in both flanks. Assuming that there was a perforation high up in the gastro-intestinal tract, the pyloric region, duodenum and gall-bladder were examined without one being found. A drain was placed in the pelvis and another in the right side. Temperature, pulse and respiration rose steadily until the patient died fourteen hours later. A culture made at operation showed streptococci.

*Autopsy.*—The intestines for the most part are smooth and shiny but many flakes of fibrin are scattered over their surface and several hundred c.c. of reddish turbid fluid occupy the dependent parts of the abdominal cavity. The appendectomy site is perfectly closed and in good order. There are no adhesions or other disturbances referable to the operation. The intestines were examined from end to end and showed no sign of perforation, nor did the stomach, duodenum, gall-bladder and other viscera. Both pleural cavities contain one hundred to two hundred c.c. of fluid, on the left side cloudy, and slightly blood stained; on the right side clear. The pericardial sac contains a normal amount of fluid. Heart negative. Left lung is attached to the diaphragm by a liberal coating of yellow fibrin. It is highly œdematous and there are scattered groups of minute miliary tubercles in the upper lobe. In the right lung the upper and middle lobes are œdematous. The lower lobe is solid, bright red, flabby, airless, and on section highly glazed and brilliant red, resembling the red hepatization of croupous pneumonia, but differing from it in not being swollen, friable or firm. The spleen is large and contains a considerable number of yellow infarcts of hæmatogenous and pyogenic origin, some on the surface and some deeply situated. The adrenals are quite œdematous, the cortical substance being yellow, the medullary substance bright red. The kidneys present the swelling of the cortex supposed to signify acute parenchymatous nephritis. Ureters, bladder and prostate normal. Duodenum and pancreas normal. Liver appeared normal, but cut surface was highly glazed and has a peculiar orange tint for which no explanation is apparent.

#### DISABLING MUSCULAR ANOMALY OF HAND

DR. D. B. PFEIFFER described a case of supernumerary extensor of the digits which had interfered with the work of a pianist.

DR. ADDINELL HEWSON said this condition is very rare. The difficulty resembles, in a measure, the bridle between the middle, ring finger and little finger on the extensor tendon of the ring finger and proceeding to the two others named. This bridle prevents the act of trilling with the ring finger, when the middle and little finger must

hold the piano key down. The operation as done by the late Dr. W. S. Forbes of this city, in dividing this accessory tendon of the ring finger, has been reported in the literature. The fact, however, that it does give great relief in this mechanical movement of the pianist and flute player, is very evident. Quain's *Anatomy*, page 231, indicates the possibility of the occurrence of the fasciculi as outlined by Dr. Pfeiffer. It seems possible, from the attachment of this accessory muscle to the long extensor tendon, to divide its attachment to the long extensive tendon and thus relieve the bridle effect, or checking effect, upon the tendon in question.

### TRAUMATIC SPONDYLITIS

DR. L. W. FRANK, by invitation, presented a man, aged forty-two years, who in May, 1914, tripped and fell, striking his back on a tree. The injury was not severe and he continued his work. That evening he noticed a small lump on his back which later practically disappeared. He could walk, and continued work, though at times he had slight pain in the back with neuralgic pains radiating around both sides of the abdomen. About four months later the pain in his back became quite severe, so much so that he could not lie down and had to sleep in a chair. Turning or twisting caused severe pain in the back radiating down the legs.

Eight months after the accident, the pain was so severe he could not move. He remained quiet for two months, spending most of his time in a chair, after which he got up and wore a brace. Since then he has gradually improved. At present he has no pain while lying down but the slightest jar or twist produces very severe pain in the back radiating down both legs, and he still has neuralgic pain radiating around his abdomen. He has no paræsthesia in the legs or abdomen. Since the accident he has had gradual loss of sexual desire and power. Since the accident patient has had swelling of the right leg which develops during the day and diminishes at night. At times the leg becomes very large indeed. There have been no gastro-intestinal or pulmonary symptoms.

Examination reveals a thin, stoop-shouldered man who holds himself quite rigid, though he has some tendency to bend forward. He walks slowly and with great care. The spine of the twelfth dorsal vertebra is prominent and quite tender to pressure. Below this level there is slight curvature of the spine to the left, and the spine is held rigid and immobile. Above this point the vertebræ are movable. The patient cannot stoop over, and when picking objects off the floor he does

so by flexing the thighs and knees. There are no sensory disturbances in the back, abdomen or legs. Both knee-jerks and Achilles jerks were slightly exaggerated. There is no Babinski nor ankle clonus.

The rest of the examination is entirely negative. Urine analysis is negative. Blood count reveals 5,000,000 red blood-cells with 75 per cent. hæmoglobin and normal leucocytes and differential count. Wassermann is negative. Von Pirquet is negative at the end of thirty-six hours. X-ray reveals bone destruction in the lumbar and lower thoracic vertebræ, with curvature and ankylosis of the lumbar spine.

This case conforms with the 3 points characteristic of traumatic spondylitis or Kümmel's disease. First, the injury. Second, period of practical freedom from pain during which neuralgic pains are frequently present. Third, reappearance of the pain with development of cord symptoms and kyphosis.

The only condition from which this disease must be differentiated carefully is Pott's disease. This differentiation is extremely difficult to make. In Pott's disease there is frequently a history of trauma followed later by pain in the back, kyphosis and ankylosis. However, in Pott's disease often other foci of tuberculosis are found, and this condition is more frequently found in children than in adults. The radiogram cannot aid very much in making a differential diagnosis in our case, as the condition had gone on to ankylosis and the X-ray picture of this case cannot be differentiated from that seen in old Pott's disease.

In 1891, at the Congress at Halle, Kümmel described a condition which he called traumatic spondylitis. This condition is always caused by trauma to the spine, either direct or indirect, producing a compression of the vertebral body. At the time of the trauma, patient experiences some pain in the spine, but later this disappears for days, weeks, or months, though in some cases it persists from the time of the trauma, gradually becoming worse. Several weeks or months after the accident, the patient again suffers pain in the back, accompanied by intercostal neuralgia, motor disturbances, sometimes slight in the lower extremities, with some uncertainty of gait. Later he develops a gibbosity and an associated kyphosis.

Kümmel does not attribute the condition to a fracture of the body of the vertebra for the trauma is always too slight to produce that. He considers that as a result of the trauma there develops a disturbance of nutrition (rarefying osteitis) which leads to atrophy of the two surfaces by compression ulceration. Kümmel considered such cases to be types of traumatic spondylomalacia. Similar cases have been

## ENDOTHELIOMA OF THE SPINAL CORD

described by Henle, Heidenhain, Schultze and others, and in 1910 Mme. Temkin was able to collect 64 such cases.

DR. A. P. C. ASHHURST said that in the second volume of the *Episcopal Hospital Reports* (1914) his assistant, Dr. R. L. John, has recorded several cases of traumatic spondylitis. In these cases the diagnosis was based upon the fact that the original injury was very severe, causing the patient to come to the hospital and be laid up for some time. The first patient had fallen out of a third story window, landing on his feet. The second patient put his head in an elevator shaft and the elevator came down on him. The third patient fell nine feet from a ladder, landing on his head. The fourth patient was knocked down by a trolley car. The subsequent disability developed gradually weeks or months after the original injury, and it was necessary to exclude tuberculosis and syphilis as possible factors in the etiology. In the fourth patient, with disease in the lumbar region, about two years after bone transplantation was done for the kyphos which gradually resulted from his traumatic spondylitis, he developed a gumma following another recent injury over the former site of the disease. Though there was no history of syphilitic infection, he had a plus four Wassermann, but that did not change the opinion that the original trouble was traumatic spondylitis, the syphilitic infection being independent. He had been entirely relieved of his spinal symptoms since the operation, and the appearance of the gumma did not cause them to return.

It is a well-known fact that following a single severe traumatism one may get bone atrophy, as is especially seen in fractures of the neck of the femur, which almost universally terminate in shortening even when bony union occurs, and it is quite reasonable to suppose that a severe injury in the vertebral bodies, even without fracture, will produce bone atrophy also. In the cases observed in the cervical spine (Cases II and III), in which region the vertebral bodies are of insignificant size, the bone changes have been confined chiefly to the articular processes, where apparently most of the injury had spent itself.

## ENDOTHELIOMA OF THE SPINAL CORD

DR. CHAS. H. FRAZIER reported a case of endothelioma removed from the spinal cord at the level of the second cervical vertebra. A lady in her sixty-fourth year, first complained of pain in the right shoulder eighteen months before her admission to the University Hospital. The initial period of root irritation continued eight

months before the second period was introduced with numbness of the right fingers and hand, and two months later weakness at first, and later complete paralysis of the right upper extremity. The examination elicited, briefly, tenderness in the neighborhood of the third cervical vertebra, spastic paralysis and sensory disturbances of the right upper extremity, paræsthesia of the left arm and leg, total loss of sensation for touch, pain and temperature in the left leg, and partial loss in the right; spasticity of both lower extremities and weakness of right leg and ankle. The biceps and triceps reflexes were exaggerated, and there was ankle clonus and a Babinski reflex on the right side.

The operation, performed under local anæsthesia, included the removal of the second, third, fourth and fifth spinous processes and the laminæ of the second, third and fourth cervical vertebræ. The tumor, when exposed, in the upper portion of the exposed canal, appeared at first to be intramedullary, but when an enveloping membrane, possibly the pia, was removed, the tumor was found to be extramedullary, attached to the dura, from which it probably originated. The cord was displaced to one side, and appeared to be reduced to one-half its normal diameter. The tumor was removed by sharp dissection, and with it one sensory root, which, surrounded by the growth, had to be sacrificed. The wound was closed with five layers of sutures, one each in the dura, muscles, aponeurosis, superficial fascia and skin. Convalescence was uneventful and by the time the patient left the hospital, thirty-five days after the operation, some power had already returned to the paralyzed arm and the patient could stand and walk with a little support. The interesting features of the case were the characteristic history, the accurate localization, the unusually high location of the tumor, the uneventful recovery, and the rapid restoration of function.

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## EXOPHTHALMIC GOITRE \*

IMPORTANT FEATURES FROM THE STAND-POINT OF THE CLINICAL SURGEON

BY ALBERT J. OCHSNER, M.D.  
OF CHICAGO

IN order to establish a reasonable basis for employing surgical treatment for the relief of exophthalmic goitre it seems proper to give some attention to the histological findings in portions of the thyroid glands removed from patients suffering from this condition. To what extent this pathological condition may return to normal in cases that have not been operated, it is, of course, impossible to say. There are certain facts, however, which would indicate that the thyroid gland may undergo pathological changes to such an extent as to produce a marked degree of hyperthyroidism, and that under favorable conditions, these pathological changes may subside sufficiently to leave the patient quite free from hyperthyroidism. Many such cases have been observed clinically, and we have a physiological condition which virtually duplicates these pathological changes, and which in most instances, ultimately leaves the patient and her thyroid gland in a perfectly normal condition. I refer to the goitre of adolescence.

Many of the typical symptoms of hyperthyroidism, such as enlargement of the thyroid gland, extreme nervousness, a certain degree of tachycardia, a slight muscular tremor, more or less marked muscular weakness, sweating, and sometimes a slight amount of exophthalmos, may characterize this condition. Notwithstanding these symptoms, physical, mental and emotional rest, good hygiene, pure drinking water and the use of proper diet will result in the disappearance, in the vast majority of cases, of all the symptoms of hyperthyroidism, as soon as the physiological demand for an increased secretion of the thyroid gland for trophic purposes has disappeared. The necessity of the body

\* Read by invitation before the Philadelphia Academy of Surgery, May 8, 1916.



to produce marked increase in the size and form of the skeleton, in the breasts, and in other portions of the body, requires a physiological increase in the thyroid secretion during this period of adolescence. So long as there is a reasonable balance between the physiological demand and the physiological secretion, no permanent harm seems to come to the tissues. On the other hand, if the balance is markedly disturbed because of some form of irritation, so that the secretion becomes quite excessive, then the tissues of the body seem to suffer permanently. Landstrom has shown that in all cases in which the hyperthyroidism has resulted in an actual dilatation of the heart, the condition of this organ never returns to normal, even though the removal of a sufficient portion of the thyroid gland to overcome the hyperthyroidism may result in a fairly normal pulse beat and in the disappearance of all other symptoms of hyperthyroidism.

Another illustration of physiological hyperthyroidism is quite common during the period of pregnancy, probably because an unusual amount of new tissue has to be produced as represented especially in the skeleton of the child. Here again, if the balance is not markedly disturbed, conditions almost always return to normal.

Wilms has pointed out an interesting form of hyperthyroidism which occurs in medical students coming from regions where goitre is endemic. He found that these students with greatly enlarged thyroid glands would enter the medical department of the university free from hyperthyroidism, but that in a relatively short time, a more or less marked condition of hyperthyroidism could be determined. His explanation is as follows: The hypertrophy of the thyroid gland is probably a physiological development for the purpose of protecting the individual against the harmful effect of goitre-producing substances contained in the drinking water of these regions. So long as this protection is needed because the individual continues to drink the infected water, hyperthyroidism is not present, but when these individuals go to the city in which the medical school is located and drink water that does not contain the goitre-producing substances, then the enlarged thyroid glands secrete superfluous thyroid substance which cannot be neutralized because of the absence of the irritating material in the drinking water, and consequently the symptoms of hyperthyroidism appear.

Morian has suggested that the normal thyroid gland takes the iodine which enters the human body through the food and changes it into organic iodine, and that when this form of iodine is supplied to the human body through the stomach in the form of thyroid extract in large quantities, or in the form of potassium iodide, that then the thyroid

## EXOPHTHALMIC GOITRE

gland may produce an abnormal amount of this organized iodine; that, on the other hand, the thyroid gland in patients suffering from hyperthyroidism without the ingestion of an abnormal amount of iodine has the peculiar ability of flooding the system with an abnormal iodine product which has the poisonous effect producing the recognized symptoms of hyperthyroidism.

There can be no doubt but what the thyroid gland can be forced to produce an excessive amount of a substance causing a condition which Moebius has called hyperthyroidism, even though the gland had previously supplied only a normal amount of secretion. Ordinarily this increase is the result of some form of physical or mental or emotional irritation. I have personally observed it as a result of extreme physical or mental or emotional exhaustion caused by conditions so varied in character that it seems doubtful whether there can be any cause of such exhaustion which may not result in hyperthyroidism.

The conception of hyperthyroidism by Moebius thirty years ago, if accepted, would naturally have led to the surgical treatment of exophthalmic goitre, had it not been for the fact that the condition of the patient's heart in cases suffering from exophthalmic goitre would naturally be looked upon as a contra-indication to any serious operation. Fortunately, von Rehn had removed two goitres in 1884, notwithstanding the presence of the typical symptoms of exophthalmic goitre, not for the purpose of correcting these symptoms, but for the purpose of curing the goitre to whose presence these symptoms had not been attributed, and, to his astonishment, he found that the patients did not only recover from the goitre operation but also from the symptoms which we now attribute to hyperthyroidism. So that two years later, when Moebius brought out his theory, the foundation for surgical treatment of exophthalmic goitre had already been laid.

I performed my first operation for the relief of exophthalmic goitre in 1891, twenty-five years ago, and repeated the observation which von Rehn had made. The patient's pulse, which had been one hundred and forty beats per minute before the operation, came down to seventy beats during the time that the patient was in the hospital, and the patient has constantly remained normal, so far as any symptoms of hyperthyroidism are concerned, since that time.

About six years ago my attention was directed to the interesting histological findings in specimens of thyroid gland tissue removed from patients suffering from exophthalmic goitre, in a paper read by Louis B. Wilson. I have personally examined carefully the microscopic sections of every thyroid gland which I have removed since that time from

patients suffering from exophthalmic goitre, 507 in all. I can confirm, in a general way, the interesting observations made by Wilson. Dr. Spensely, of the Chicago University, has also made extensive studies which will probably still further clear up this part of the subject. In a general way, every thyroid gland taken from a patient suffering from exophthalmic goitre shows unmistakable evidence of structural conditions which account for increased secretion and for increased absorption of this substance. In many instances, the first section we have examined has failed to show the structural changes, but we have invariably been able to find in some portion of the gland removed, lobules which showed this characteristic hyperplasia, which in many cases is quite circumscribed, while the greater portion of the gland removed may show simple hypertrophy or colloid enlargement.

The subsequent history of cases in which the thyroid gland has been removed for the purpose of relieving the condition of hyperthyroidism has also confirmed the correctness of the theory of Moebius.

*Surgical Treatment.*—The consideration of exophthalmic goitre by the clinical surgeon begins at the point at which it ends for the practitioner of internal medicine. The patient suffering from this disease should not be considered a surgical patient until the fact has been established that she cannot be permanently relieved of the disease as a result of carefully applied rest, both physical and mental as well as emotional, until a carefully regulated diet has been employed for a reasonable length of time, until she has been subjected to the best possible hygienic conditions that can be obtained for a person in her circumstances, and until the few remedies which seem to be of value in the treatment of such cases have been thoroughly tried.

It might be stated at this point that these remedies should never include the use of thyroid extract, the use of digitalis, or the use of iodine, although the very minutest doses of the last remedy mentioned may at times be harmless, but probably also useless. We have seen a number of deaths that could be fairly attributed to the use of each of these three remedies, and we have never seen a case in which one of these remedies, or any combination of them, has been of the slightest benefit to the patient.

In speaking of the dietetic treatment, not only before, but also during, the time that these patients are under surgical care, and above all things, after the surgical treatment has been concluded, too much stress cannot be laid upon the importance of giving these patients an abundance of absolutely pure drinking water, or, if this is not available, upon insisting that all water taken by the patient be carefully boiled.

## EXOPHTHALMIC GOITRE

Limiting surgical treatment to patients belonging to the class which is covered by the above definition, the time of operation must next be considered. Too frequently the patient and her friends and her family physician become convinced that she requires surgical care because this promises the only hope for her recovery, at a time when the patient is at the height of a period of exacerbation. Under the supposition that the sooner the patient can obtain the benefit of surgical relief the better it will be for her, an immediate operation is planned. Surgeons with a large experience in the treatment of these conditions are agreed upon the fact that this plan must result in a considerable number of avoidable fatalities, because these exacerbations are almost invariably followed by a lull in the severity of the condition, and if this period is awaited, the margin of safety is widened to an amazing extent and the percentage of mortality is correspondingly reduced. By a margin of safety one would mean in these cases a condition which would make it almost certain that the patient under consideration will recover in case the operation is performed, and the more nearly certain the surgeon can be of this, judging from the condition of the patient at the time of the operation, the wider would be the margin of safety. This margin of safety, however, depends not only upon the condition of the patient herself, but also to a large extent upon her mental attitude, upon which Crile and others have laid so much stress. If the patient is not thoroughly convinced that she will recover if the operation is performed, her chances of recovery are greatly diminished, and if the patient is at all frightened at the time for which the operation has been set, this should be postponed until she has attained the necessary confidence.

In cases in which the margin of safety does not seem sufficient to warrant the excision of a sufficient amount of the diseased thyroid gland to promise a complete and permanent recovery to the patient, the surgeon should limit his operative work to the amount that the patient can safely bear. If it seems safe to remove one lobe, that should be done. If it seems safe only to ligate one or two or three of the principal arteries and veins, then this should be the limit of the operation. It is in determining the extent of the operation that the patient can safely bear, that the surgeon has an excellent opportunity of showing surgical judgment in the treatment of these cases.

It has seemed to us that ligations of vessels have been more effective if the regular horse-shoe incision is made, that one uses in performing thyroidectomy, and if the enlarged veins located anteriorly to the thyroid gland are all clamped and ligated, as well as the superior and inferior thyroid arteries and veins on the side of the gland most infected,

effect, but its most important use lies in the fact that it prevents the accumulation of mucus in the pharynx and thus prevents the inspiration of mucus during the operation. Since we have employed this method our patients have been entirely free from ether pneumonia.

There is still a further method by means of which the amount of ether necessary can be greatly reduced. If the patient is thoroughly anæsthetized before the operation is begun, and if then the head of the table is elevated so that the body of the patient takes a position of forty-five degrees, the resulting anæmia of the brain will keep the patient anæsthetized for a sufficient period of time to enable the surgeon to perform the entire operation, from the time of making the first incision to the time of placing the last suture, without giving the patient any additional anæsthetic. Consequently, the patient will exhale ether throughout the period occupied for performing the operation without taking in any additional ether, and as soon as the head of the table is lowered, the patient is quite fully awake, and after the dressing is applied and the patient is placed in her bed, she is quite sufficiently awake to be permitted to sit up, which will further prevent the occurrence of ether pneumonia. Unless this precaution is taken, the patient is often returned to her bed quite saturated with ether, her pharynx is likely to be filled with mucus, and there is frequently a severe irritation of the larynx because of the manipulations necessitated by the operation, and the chances of ether pneumonia are very much greater.

Before returning the patient to her bed, it is of the greatest importance in all cases that have shown marked symptoms of hyperthyroidism to perform gastric lavage, using water at a temperature of 110° F. for this purpose. The mucus which accumulates in the stomach seems to increase the post-operative hyperthyroidism, and patients in whom gastric lavage has been made according to the method described seem to suffer very much less from this post-operative complication.

In order to eliminate entirely the danger from the anæsthetic, thyroidectomy may be performed under local anæsthesia by the use of  $\frac{1}{2}$  of 1 per cent. of novocaine with five drops of adrenalin chloride, 1 to 1000, to 1 ounce of the novocaine solution. If the surgeon's personality enables him to have a quieting effect upon the patient to such an extent that she will not suffer mentally from having the operation performed while awake, this method has many advantages. It has the further advantage of preventing traumatism. Many surgeons will perform an operation under local anæsthesia with almost no traumatism, while they habitually traumatize the tissues to a marked extent when operating upon the anæsthetized patient. In case the surgeon is habitually

and if the patient seems to be in sufficiently good condition, the superior thyroid artery and vein on the opposite side may be ligated at the same time.

As to the use of boiling water in those cases in which the margin of safety is too narrow to warrant a more extensive operation, in a few patients in whom we have tried this we have been very well pleased with this operation, but our experience is too limited for us to speak authoritatively on this subject.

Whatever the preliminary operation may be, however, it seems wise to give the patient the same careful after-treatment as though a radical operation had been made and to make the radical operation when the patient has obtained the greatest amount of benefit from the preliminary operation. Whenever we have failed to make the radical operation because of the apparent improvement after the preliminary operation, we have been disappointed in the ultimate result, because all of these patients have relapsed; while if we have removed the offending gland after the patient has picked up following the preliminary operation, our results have been eminently satisfactory.

This margin of safety can be enormously widened by administering from 400 to 600 c.c. of normal blood at the beginning of the operation for the excision of a thyroid gland by means of the modified Kimpton tube, which was introduced by my colleague, Dr. N. M. Percy. The blood can be introduced into one of the anterior jugular veins. This portion of the operation requires less than ten minutes and can consequently not increase the danger of the operation itself, while it improves the patient's condition enormously. Of course, it is important to have the donor's blood examined in order to choose a donor whose blood will not cause hæmolysis when introduced into the patient's vein.

Next to this comes the danger from the use of anæsthetics. The only general anæsthetic that seems safe to use in these cases by surgeons in general, is ether administered by the drop method. It is, however, very much better to give the patient a hypodermic injection of  $\frac{1}{4}$  grain of morphia and  $\frac{1}{100}$  grain of atropin one-half hour before the anæsthetic is begun. The advantage of this practice lies in the fact that the patient becomes quiet, is not sensitive to the consideration of the impending operation, and throughout the operation she is far less sensitive to pain, and consequently the total amount of ether which it is necessary to administer is very much less than it would be were this preliminary treatment omitted. Moreover, the patient will be returned to her bed with almost no ether in her circulation, while without this, she will be saturated with this poison. The atropin has also a quieting

violent in his surgical manipulations he should perform his thyroidec-tomies under local anæsthesia. There can be no doubt but what the likelihood of post-operative hyperthyroidism is greatly increased if the tissues are severely traumatized.

The loss of blood seems to have the same effect. It is consequently wise always to clamp each vessel between two hæmostatic forceps, cut between these and ligate. In this manner the entire operation may be performed with the loss of almost no blood, and the field of operation being constantly clean and free from blood, the surgeon is enabled to perform the operation with much greater facility. The tissues at the close of the operation will not be saturated with blood, the absorption of which according to Kocher also increases the likelihood of hyperthyroidism. For the same reason it is well invariably to apply drainage to these cases. Of course, all of these precautions are important from the stand-point of preventing shock at the same time that they prevent hyperthyroidism.

A great deal has been written and said concerning the importance of preventing injury to the recurrent laryngeal nerve and the parathyroid gland. In studying the literature of the subject, I have been struck by the fact that the surgeons who expose these structures for the purpose of protecting them, by laying bare the inferior thyroid artery and ligating the latter at a point external to its crossing the recurrent laryngeal nerve, are likely to have a considerable amount of paralysis of the recurrent laryngeal nerve at least temporary in character; because laying bare the recurrent laryngeal nerve, which is not much larger than an ordinary sewing thread, is very likely to result in an injury to this delicate structure. The ligation of the inferior thyroid artery at this point is likely to interfere with the blood supply of the inferior parathyroid gland, because this structure frequently obtains the greater portion of its blood supply from a branch of the inferior thyroid artery internal to this point. Injury to both of these important structures can, however, easily be prevented by bearing in mind the fact that both of these structures are located at the point at which the lateral lobe of the thyroid gland touches the trachea, and that they are both located behind the posterior capsule of the thyroid gland. Consequently, if the inferior thyroid artery is grasped in front of the posterior capsule of the thyroid gland, and if the portion of the posterior capsule of the thyroid gland is left undisturbed over the area at which the thyroid gland and the trachea are in close apposition, it is quite impossible to injure either the recurrent laryngeal nerve or the inferior parathyroid gland. Occasionally, however, one encounters aberrant arteries in this region, and in this case

## EXOPHTHALMIC GOITRE

one often has quite a little spurt of blood from one of these structures, and in applying forceps for the purpose of stopping this little hemorrhage it is quite possible to grasp through the posterior capsule and to injure one or both of these two important structures.

The veins in exophthalmic goitre are often so greatly dilated that it is well to bear in mind the possibility of air embolism in case one of these veins should be cut during inspiration of the patient and should be held open accidentally by means of forceps. It is also important to guard against rapid injection of novocaine in these cases because there is danger of forcing a considerable quantity of this fluid into a vein which might carry it to the heart, causing immediate death as a result of inhibiting the heart's action.

In patients who have suffered from the presence of a simple goitre for many years, in whom some portion of the goitre has later degenerated into the exophthalmic form, it occasionally happens that the old hard goitre has caused an absorption of one or more tracheal rings, and when the goitre has been removed, the trachea may collapse. If this occurs, the trachea should immediately be opened and a cannula should be inserted.

*After-treatment.*—By far the most important point in the surgical consideration of this condition consists in the after-treatment, because with careful after-treatment almost all of these patients may become nearly as useful as they were before they began to suffer from exophthalmic goitre, while in cases in which the after-treatment is not carefully carried out, practically all of these patients develop a condition as bad, if not worse, than that with which they presented themselves primarily for surgical treatment. The surgeon should bear in mind in the first place that practically all of these patients belong to a class of neurotics, and that this undoubtedly had much to do with the development of their goitres primarily, and that unless this condition is carefully taken into consideration in the after-treatment, the weakened physical condition of the patient will not be able to bear the wear and tear to which the neurotic tendencies would surely expose the patient. The same is true concerning the diet which is habitually chosen by the patients, which is usually exceedingly unwholesome, and it is consequently important that they be impressed with the fact that unless they will adhere to the use of a reasonable diet, their chances for a permanent recovery will be very slight. We have always given these patients printed directions which contain all of the important rules to be observed, and we have advised the patients to read these directions at regular intervals and to follow them for many years. The following is



a copy of the directions which we use in these cases, and which have proved eminently satisfactory. The patient receives a mild tonic and a laxative and an absolute diet list upon leaving the hospital.

RULES FOR GOITRE PATIENTS

1. You should avoid all excitement or irritation like attending receptions, shopping, church work and politics.

2. You should get an abundance of rest, by going to bed early and taking a nap after luncheon.

3. You should have an abundance of fresh air at night, consequently, you should sleep with wide open windows or on a sleeping porch.

4. You should eat and drink nothing that irritates the nervous system, like tea, coffee, or alcohol. Of course you should not use tobacco in any way.

5. You should eat very little meat. If you are very fond of meat, take a little beef, mutton or breast of chicken or fresh fish once or twice a week or at most three times a week.

6. You should drink a great deal of milk or eat things that are prepared with milk, such as milk soup, milk toast, etc., cream and butter-milk are also especially good for you.

7. You should avoid beef soup or beef tea or any kind of meat broths.

8. You should eat an abundance of cooked fruits and cooked vegetables, or very ripe raw fruits, or drink fruit juices prepared out of ripe fruits.

9. You may eat eggs, bread, butter, toast, rice, cereals.

10. You should drink an abundance of good drinking water, or if this is not available, you should boil your drinking water for twenty minutes or drink distilled water.

With the exception of a very small number of cases in which an insufficient amount of the gland had been primarily removed, or in which the remnant which had been left at the primary operation had increased in size, in practically all of the cases which have come to us with a recurrence, either from among those that we had personally operated or those that had been operated by other surgeons, we have almost invariably found that they had either disregarded the directions given regarding diet and rest and hygiene following their operative treatment, or they had been permitted to return to their homes without definite instructions in this direction. It is therefore very important that written or printed directions be given these patients and that they be thoroughly impressed with the importance of using these directions.

# THE SURGICAL TREATMENT OF GOITRE\*

HOW CAN THE RESULTS ACHIEVED BE IMPROVED?

BY MILES F. PORTER, M.D.

OF FT. WAYNE, IND.

My title presupposes two things. First, that the results achieved in the surgical treatment of goitre are not satisfactory. Second, that it is possible to improve upon the results heretofore achieved in the surgical treatment of goitre.

It will not be necessary for me to occupy your time or try your patience in presenting proof of the first assumption. You need only recall your own experiences together with the results reported from other sources to bring you into entire agreement with it.

We shall proceed, therefore, at once to consider the various causes of failure in the surgical treatment of goitre and the possible means of avoiding them. We find that a certain percentage of cases of toxic goitre (and I use the term toxic here to include exophthalmic goitre) die without operation; a certain percentage die as a result of operation; another small percentage die in spite of operation, or after operation as the result of recurrence.

Quite a number of those cases of goitre which die without operation have been refused operation largely on the ground of other pathological conditions, among which diabetes and nephritis hold a prominent place. The coexistence of either nephritis or diabetes with hyperthyroidism should be considered rather as an argument for than against operation. O'Day<sup>1</sup> and others have shown that the cure of hyperthyroidism by surgical measures has been followed by the disappearance of sugar from the urine in these patients and the establishment of a normal sugar tolerance, while the disappearance of the signs of kidney inadequacy coincidently with those of hyperthyroidism has frequently been observed.

According to Rogers,<sup>2</sup> "only about 25 per cent. of cases of hyperthyroidism are improved by hemithyroidectomy, and some 10 per cent. of them are not benefited at all or made worse, and the general operative mortality is at least 5 per cent." I feel that the number of deaths from goitre, including those following operation and those occurring without

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\* Read by invitation before the Philadelphia Academy of Surgery, May 8, 1916.

operation, would be reduced if judicious surgery were employed earlier and more frequently. A more careful search for the vascular phenomena in cases of possible hyperthyroidism may enable one to reach a diagnosis earlier than could otherwise be done. Osler<sup>3</sup> has pointed out the fact that a thrill may be present in the thyroid when the gland is not enlarged. Riesman<sup>4</sup> has recently called attention to a bruit over the eyeball that may be an aid in diagnosis. Rogers,<sup>5</sup> in discussing the subject of goitre before the New York Surgical Society, April 10, 1912, said that excision should never be done in symmetrical enlargement of the thyroid nor in thyroid enlargement in the young, and that the same rule applied in colloid goitre as well as to the goitre of Graves's disease. Of course, no one would advise general or even frequent resort to surgical treatment in goitre occurring in young girls, but in the writer's opinion this teaching, without material qualification, is pernicious, for the reason that in his experience goitre occurring in boys is quite as apt to continue and to give trouble as is goitre occurring at a later age, while some of the most severe cases of toxic goitre that he has seen occurred in women who had carried their goitres from puberty, and the history clearly shows in many of these cases that there was a time when proper surgical treatment might have been carried out with less risk and much greater assurance of a satisfactory result than when they finally submitted to operation. It should be the rule to remove all permanent goitres whether they are producing symptoms or not. Were this rule followed there would be fewer cases of toxic goitre. Personally, I believe that there is as much reason for removing so-called simple goitres with a view to preventing them from becoming toxic as there is for removing or curing by surgical means certain lesions, such as warts, moles, and chronically inflamed areas, to prevent them from becoming malignant. If this rule were followed it would largely eliminate the deaths from so-called degenerating simple or toxic goitre. And it will be remembered in this connection that C. H. Mayo and Plummer<sup>6</sup> place the death-rate in this form of goitre at least 2 per cent. higher than that which obtains in the exophthalmic type.

The authors above quoted place the number of recurrences after operation at 10 per cent. To me it seems the part of better judgment to remove a larger part of the thyroid than is usually done, even at the risk of producing hypothyroidism, for the purpose of preventing recurrence and achieving more complete relief. Personally, for some years, I have not been content with doing a so-called lobectomy, but have removed in all cases from five-sixths to nine-tenths of the gland.

## THE SURGICAL TREATMENT OF GOITRE

This experience covers more than 100 cases and in none, so far as my knowledge goes, has there been either recurrence or symptoms of hypothyroidism.

On the other hand, within that period I have been called upon to do a number of secondary operations for patients who had previously had one lobe of the gland removed. Frequently not more thyroid tissue has been allowed to remain than would correspond in size to the half of my thumb. Another argument in favor of more complete removal of the gland is the failure to get relief from so-called hemithyroidectomy. According to Rogers,<sup>7</sup> these failures amount to 10 per cent. It seems hardly necessary for me to say that this relatively complete thyroidectomy is not advised in cases wherein it adds seriously to the risk of the operation. In such cases the operation would better be done in two stages. It is well to add here that if relatively complete thyroidectomy were substituted for lobectomy, not a few cases of malignancy would be permanently cured that otherwise would go on to a fatal end. Because of the especial frequency of malignant degeneration in nodular goitres, especial care should be taken to remove all nodular areas completely when doing a thyroidectomy (Figs. 7, 8 and 9). Not frequently deaths occur from hyperthyroidism following operations for the cure of other troubles. Naturally these accidents are growing less frequent, because surgeons are less apt to overlook mild symptoms of hyperthyroidism in these days than formerly. However, that these unfortunate accidents have not been entirely eliminated is proven by the following case, which is under my care at the present writing, suffering with a severe hyperthyroidism of the exophthalmic type.

Mrs. B., aged fifty-two, married, mother of three children, consulted me on March 30, 1916, presenting all of the symptoms of an aggravated type of exophthalmic goitre. Previous and family history were unimportant save for the following: One year prior to her visit to me she had been operated upon for gall-stones. Two days after the operation she suddenly developed severe symptoms of cardiac failure, and for some days it was thought she would die. She said she had one similar attack, not so severe, before she had her operation for gall-stones, but first noticed the enlargement of her neck six months after her gall-stone operation. Had this woman been treated for her hyperthyroidism first and subsequently operated for her gall-stones, it is fair to assume that she would now be enjoying good health.

At this point in the preparation of this paper I was consulted by a very intelligent woman in behalf of the widow of a doctor

living in California, regarding the advisability of an operation for goitre. The goitre has existed since girlhood, but never gave her any trouble until quite recently, since which time it has been "bothering her heart." She is the mother of three grown children, and within the last five years she had undergone two surgical operations, the exact nature of which could not be ascertained.

Cases like this and the one above noted are quite common. The first serves to emphasize the desirability of being on the lookout for symptoms of thyroid intoxication in patients upon whom we are about to operate for other conditions, while the second case serves to emphasize the same point; but more particularly to my mind does it emphasize the point brought out earlier in the paper, namely, the desirability of removing all permanent goitres whether they are giving rise to symptoms or not.

There remain to be discussed three sources of dissatisfaction following thyroidectomy, viz.: First, failure to get relief from the symptoms, although there be no recurrence of the goitre. Second, the immediate mortality is too high. Third, too many cases are seen which have gone beyond the point where the question of surgical relief can be entertained with reason.

The first cause of failure or partial failure can be avoided quite often by making a liberal incision and exposing the whole gland before commencing its removal. This will enable one to avoid injuring either the nerves or the parathyroids, and permit one to judge with reasonable accuracy as to the amount of gland tissue left and especially its character. This latter is important, for it is quite possible that failure to get relief after partial thyroidectomy is due to the fact that the trouble-producing part of the gland has not been removed. Very often and perhaps in the majority of cases by careful examination of the gland after uncovering it, it is possible to distinguish the hyperactive or toxic portions of the gland from the inactive or normal portions. The hyperactive and toxic portions are lighter in color, yellowish white rather than red, and not so firm as the normal gland structure. One should endeavor to remove all pathologic tissue and allow to remain only normal tissue in so far as it is possible, and where no healthy gland tissue is found, I think one is warranted in leaving only a very small part of thyroid tissue behind, for it is logical to assume that less hyperactive than normal gland tissue is necessary to perform the physiological function of the thyroid. My observations along these lines have not as yet gone far enough to warrant me in speaking at all dogmatically, but do warrant the suggestion made.

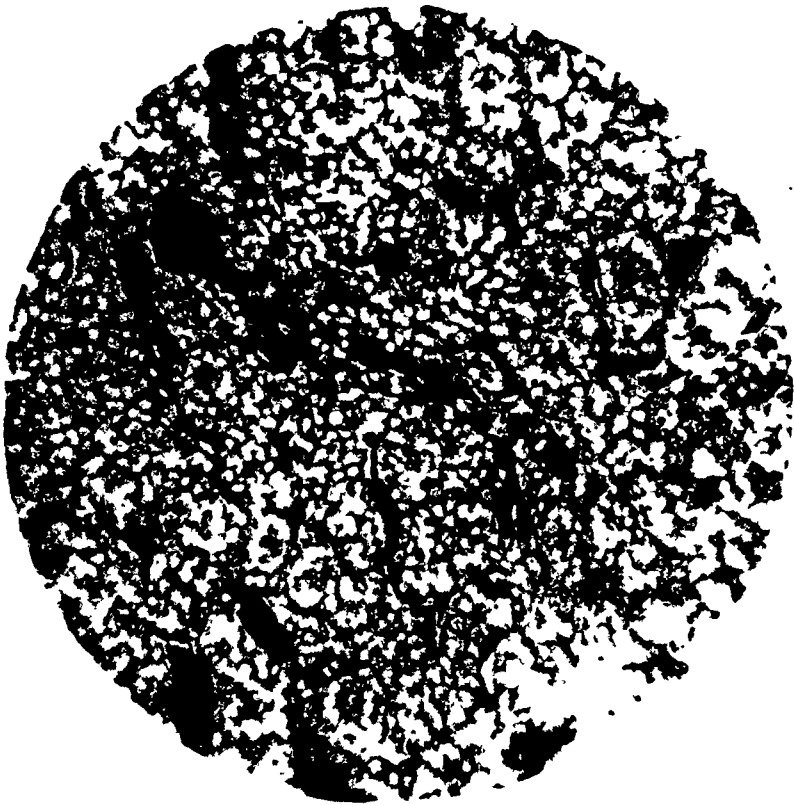


FIG. 1.—Miss B. Taken from the pale portion of the gland. Note the hyperplasia and compare with Figs. 2 and 3.

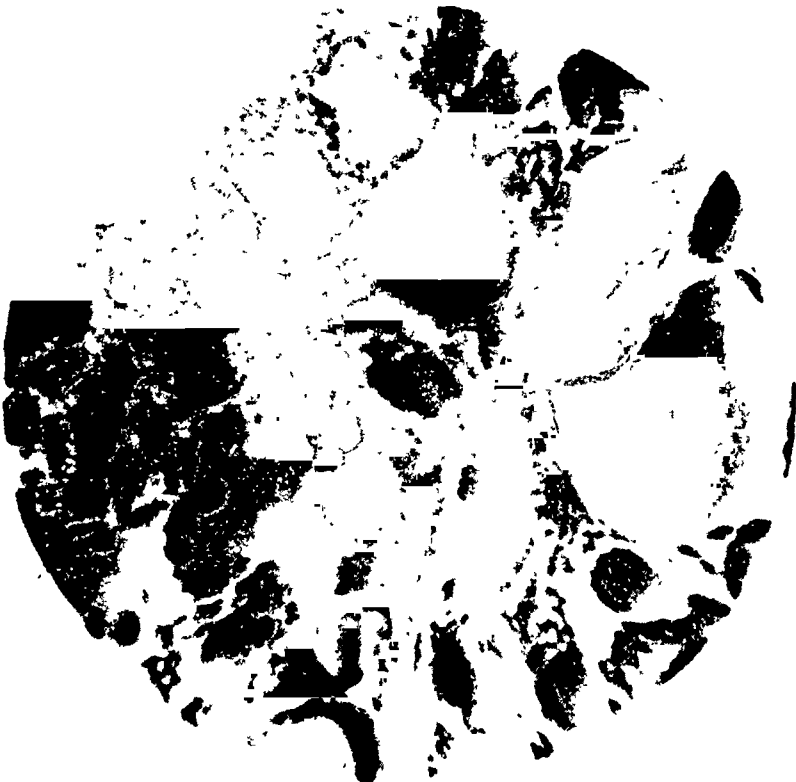


FIG. 2.—Miss B. Section from red portion of thyroid, showing very little hyperplasia and much colloid.



FIG. 3.—Miss B. Photograph of section through gross specimen, showing encapsuled tumor (A) in upper half of the picture and dark normal thyroid below (B). The tumor contained the trouble-producing tissue and was very much lighter in color and less firm than the non-hyperplastic portion.



FIG. 4.—Miss D. Section from red portion (see Fig. 6, A) of gland, showing simple goitre.



FIG. 5.—Miss D. Section from lighter part of gland (Fig. 6, C and B), showing hyperplasia.

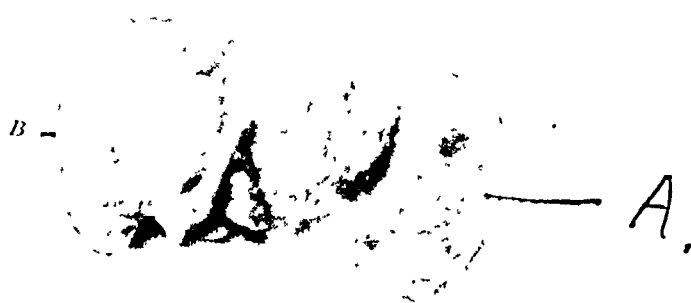


FIG. 6.—Miss D. A is the dark and B the light lobe, from which Figs. 4 and 5 were made. C shows gross section through lighter portion of the gland.



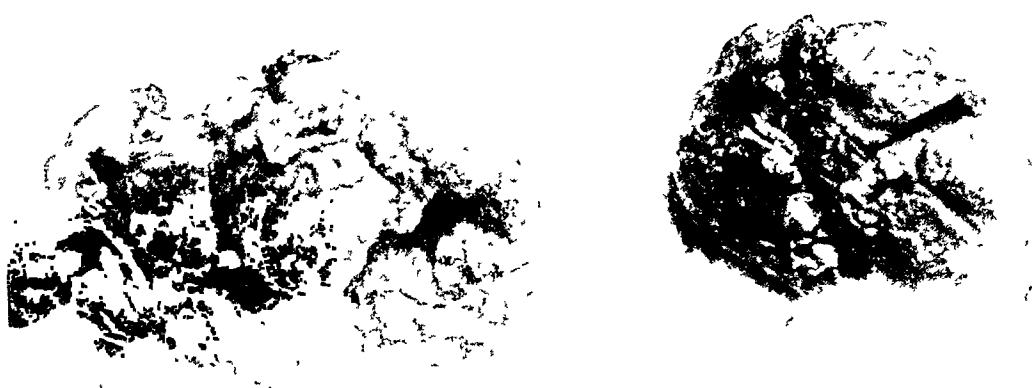


FIG. 7.—Mrs S Shows two views of gross appearance of the thyroid. The nodular condition suggests malignancy, while the light color prevailing suggests hyperplasia. This case presented aggravated symptoms of hyperthyroidism with exophthalmos. Compare with Figs 8 and 9. In this case the toxic symptoms and malignancy developed in a goitre of long standing. A timely operation in this case might have prevented both the toxic symptoms and the malignancy.

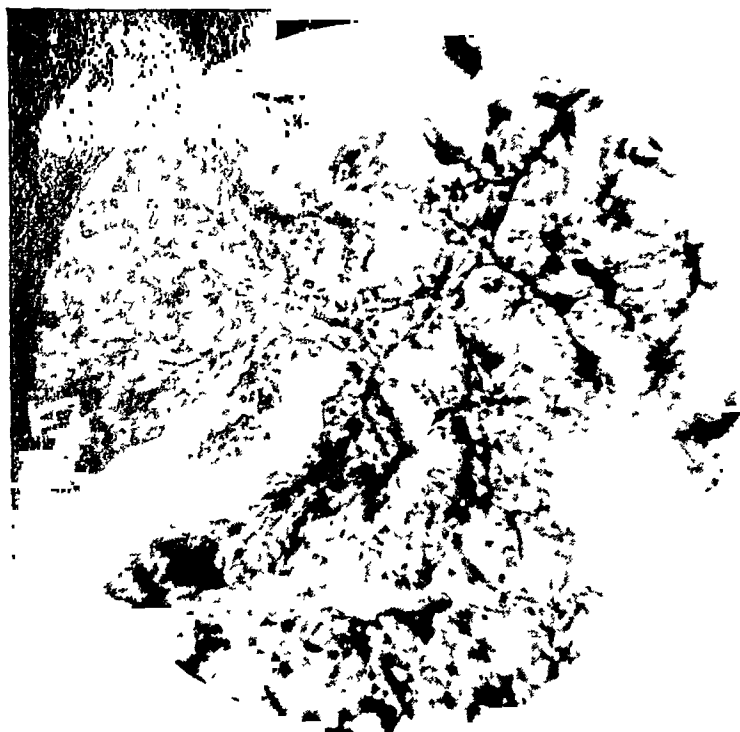


FIG. 8.—Mrs. S. Section showing hyperplasia with cytolysis.

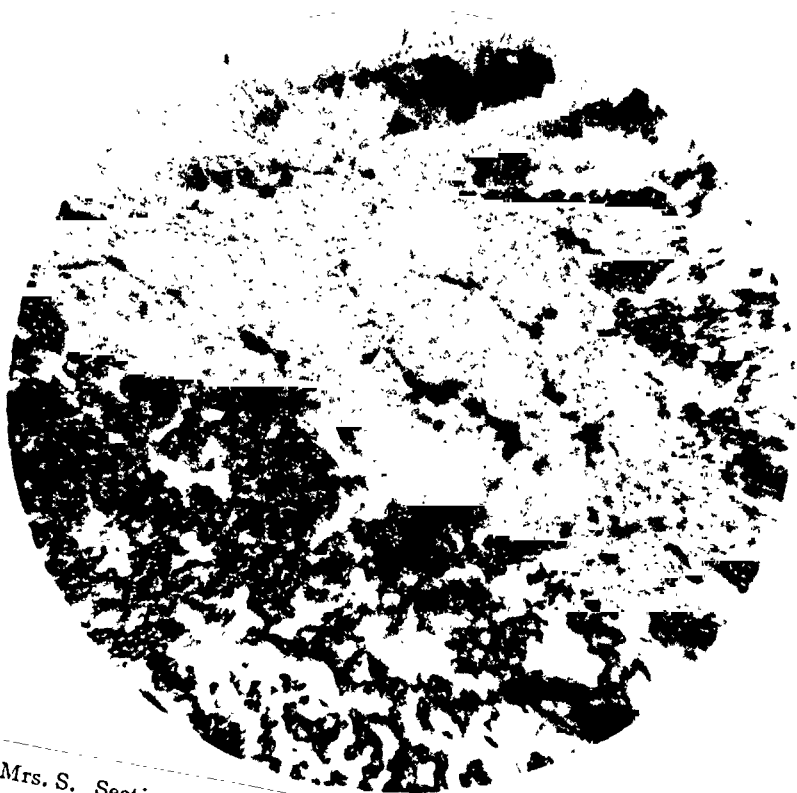


FIG. 9.—Mrs. S. Section showing hyperplasia of malignant adenomatous type



FIG. 10.—Mrs. M. Showing surface and contour of gross specimen (A) and gross section (B). This was a goitre of long standing in which symptoms of hyperthyroidism later developed. In B may be seen the white spots and streaks indicative of fibrous and calcareous changes.



FIG. 11.—Mrs M. Section showing marked hyperplasia.

## THE SURGICAL TREATMENT OF GOITRE

Figs. 1, 2, 3, 4, 5, 6, 10 and 11 illustrate very clearly the macroscopic and corresponding microscopic differences found in normal or inactive goitre tissue, on the one hand, and hyperactive and toxic goitre tissue on the other. I have made no attempt to keep an accurate account of the cases in which this differentiation can be made at operation, but am certain it can frequently be done. Since this paper was commenced I have been able to make it in 2 of the 4 cases operated within that period.

The immediate mortality of operation can be reduced by substituting boiling water injections into the gland for ligation as a preliminary to thyroidectomy in serious cases, and by using the injections to the exclusion of all operative methods, in mild cases with little or no enlargement of the thyroid, and in extremely grave cases. One or two injections will cure the mild cases and will give as much relief in the extremely grave cases as thyroidectomy and at a much less risk. In some of these extremely grave cases one is surprised by getting a satisfactory result, while in others the result is satisfactory save that the deformity is still disfiguring, and this can now be removed by operation without undue risk. In those cases in which there need be no fear of a slight operation it is better to uncover the isthmus of the gland by a small incision under novocaine and inject both lobes under guidance of the eye. With our present state of knowledge in a certain percentage of cases a certain mortality is perhaps inevitable once the symptoms have become at all pronounced. In my experience anorexia, diarrhoea, and mental derangements are especially unfavorable symptoms. I know of no way of distinguishing between the cardiac symptoms due to myocardial changes and those due to toxæmia. I would like to repeat here a statement made in the earlier part of this paper, to the effect that this so-called inevitable mortality could be reduced by removing all simple goitres before they become either toxic or malignant.

### REFERENCES

- <sup>1</sup> O'Day: American Jour. Surg., Gynæcology and Obs., vol. xxii, p. 206, February, 1916.
- <sup>2</sup> Rogers: ANNALS OF SURGERY, vol. lvi, p. 459, 1912.
- <sup>3</sup> Osler: McRea, Modern Medicine, vol. iv, p. 859, second ed.
- <sup>4</sup> Riesman: Jour. Am. Med. Assoc., vol. lxvi, No. 18, p. 1381.
- <sup>5</sup> Rogers: *Loc. cit.*
- <sup>6</sup> Mayo and Plummer: Progressive Medicine, vol. xix, No. 1, p. 88, 1916.
- <sup>7</sup> Rogers: Progressive Medicine, vol. xix, No. 1, p. 84, 1916.

# RESULTS OF OPERATIVE TREATMENT OF EXOPHTHALMIC GOITRE \*

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OF two hundred successive cases of exophthalmic goitre operated upon at the Presbyterian Hospital, Chicago, prior to December, 1914, eleven, or  $5\frac{1}{2}$  per cent., died in the hospital. To ascertain the condition of the patients who had been operated more than a year a series of questions were addressed to them. Owing to a new system of street numbering instituted in Chicago a few years ago many of our letters failed to reach the patients, but sixty-five answers were received. An effort will be made to correlate the condition of these patients before operation with their present status of health. Three divisions can be made according to the severity of the symptoms of hyperthyroidism recorded in the history sheets.

Group 1. Moderate symptoms of hyperthyroidism, such as nervousness, palpitation and tachycardia with a pulse rate of 90 to 100, goitre and perhaps exophthalmos were present, but there was no evidence of severe intoxication. There were six cases of this type. Lobectomy was done in all of them. Three patients were cured and three were greatly improved but were still nervous. Two patients had exophthalmos before operation and in both instances it disappeared after operation.

Group 2. These patients had marked symptoms of hyperthyroidism with a pulse of 100 to 120, tremor, exophthalmos, weakness, nervousness and in most instances were unable to attend to their ordinary duties. In this group were thirty-five patients. Lobectomy was done in thirty-three and double ligation in two. Eleven, 31.4 per cent., were cured, fourteen, 40 per cent., were greatly benefited, eight, 23 per cent., were slightly improved and two, 6 per cent., showed no improvement. Twenty-four of the thirty-five patients are able to work and assume ordinary responsibility. Twenty patients had exophthalmos before operation and nine of these report its disappearance since operation. Six had had a simple goitre before the onset of their symptoms. In this group 21.6 months had elapsed between the appearance of symptoms and operation.

Group 3. Nineteen very severe types of hyperthyroidism are

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## EXOPHTHALMIC GOITRE

placed in this group, with pulse over 120, great prostration, and with an exaggeration of all the well-known symptoms of hyperthyroidism. Lobectomy was done in all of these cases. Nine, 47.3 per cent., were cured, six, 31 per cent., were greatly improved, three were somewhat improved and one received no benefit from her operation. Fourteen were able to resume their ordinary duties. Of the nineteen cases fourteen had exophthalmos before operation and nine report themselves free from it. Seven had had a goitre before the symptoms of hyperthyroidism began. Symptoms were present on an average of 26.7 before operation.

Kuttner<sup>1</sup> reported the operative results in fifteen very severe cases of hyperthyroidism. Five were cured, eight much improved and able to work, and two were unimproved.

If we consider the entire group of sixty-five patients from whom we received adequate replies, thirty-two, 49 per cent., were able to attend to all duties, usual or extraordinary, twenty-one, 32 per cent., were able to attend to their ordinary duties but not able to assume unusual responsibility, and twelve, 18 per cent., are unable to work at all.

Twenty-five patients, 38 per cent., may be classed as well with no trace of their former subjective symptoms. The average duration of the disease in the cured patients before operation was 16.7 months and excepting three patients, was 9.8 months. Lobectomy was done in twenty-four cases and ligation in one. Fifteen had exophthalmos before operation and only six are relieved from it.

Classed as greatly improved but still nervous or having palpitation are twenty-six patients, or 40 per cent. of the total number. There were five in Group 1, sixteen in Group 2, and five in Group 3. The average duration of symptoms before operation was 23.1 months. Lobectomy was done in twenty-three, ligation in one and ligation with subsequent lobectomy in two. Exophthalmos was present in twelve before operation and is reported as cured in six.

There were twelve, 18.4 per cent., who showed some improvement from their operation, but were not well because of the insistent duration of some or all of the symptoms of hyperthyroidism. The average duration of symptoms before operation was twenty months. Eight patients had exophthalmos before operation and only one reports herself cured.

Three patients, two having lobectomy and one ligation, showed no improvement. The average duration of symptoms before operation was thirty-three months.

Of the sixty-five cases considered, twenty-five, or thirty-eight per cent., had had a goitre for months or years before the onset of symptoms of hyperthyroidism.

Of the operative procedures lobectomy was done sixty times, curing twenty-four, greatly improving twenty-one, improving thirteen slightly, and failing to benefit two patients.

Kuttner<sup>2</sup> reported the end results of thirty-seven cases: 32.2 per cent. were cured, 36 per cent. were much better, 16 per cent. were improved and 13.8 per cent. showed no improvement; 82 per cent. were able to work.

Von Eiselsberg<sup>3</sup> reported seventy-one cases with six operative deaths. Lobectomy had been done in sixty-six cases; 32.3 per cent. were well except exophthalmos.

Judd and Pemberton<sup>4</sup> reported the end results in one hundred and twenty-one cases operated in 1909. Fifty-six were ligated, thirty-six had primary lobectomy and twenty had preliminary ligation followed by lobectomy; forty-five per cent. were cured, 18 per cent. practically cured, 12 per cent. were benefited and 5 per cent. received little or no benefit from the operation. The average length of time that symptoms had lasted before operation was about the same in all groups, varying from nineteen to twenty-two months.

In our cases 38 per cent. were cured and 40 per cent. were greatly benefited, while Judd and Pemberton report 45 per cent. cured and 23 per cent. greatly benefited, making in each instance 78 per cent. of all cases that received a marked benefit or cure from the operation.

#### SUMMARY

In sixty-five patients operated for exophthalmic goitre from 1905 through 1914, 38 per cent. were cured and 40 per cent. were greatly benefited.

Of thirty-five patients having exophthalmos before operation only thirteen, or 37 per cent., reported themselves relieved from it.

The duration of symptoms before operation in the patients cured was sixteen months, in those greatly benefited was twenty-three months, and in those not improved was thirty-three months.

#### REFERENCES

<sup>1</sup> Kuttner: Verhandl. d. deutsch. Gesellsch. f. Chir., 1911.

<sup>2</sup> *Loc. cit.*

<sup>3</sup> Verhandl. d. deutsch. Gesellsch. f. Chir., 1911.

<sup>4</sup> Surg., Gyn. and Obs., vol xxii, No. 3, p. 269, 1916.

# THE SURGICAL TREATMENT OF PERFORATED ULCER OF THE STOMACH\*

WITH ESPECIAL REFERENCE TO THE QUESTION OF IMMEDIATE GASTRO-ENTEROSTOMY

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THE most approved methods of operative treatment of chronic ulcer of the stomach or duodenum are thorough excision of the ulcer-bearing area and gastro-enterostomy. The application of either method will depend upon the character of the ulcer, its location in stomach or duodenum, and, lastly, upon the presence or absence of associated lesions. The influence which the addition of acute disturbance within the peritoneal cavity, produced by sudden perforation, will have in modifying either one of these methods of treatment, is the basis for this communication.

The ideal method of operative treatment of perforated ulcer of the stomach would comprise the closure of the perforation plus some procedure for the cure of the underlying ulceration. The feasibility of doing anything further than a purely life-saving measure *is determined by the general condition of the patient at the time of operation and by the extent and degree of the associated peritonitis.*

It should be conceded that those patients who come to operation in an advanced stage of the acute illness, when conditions are desperate, should without exception be subjected only to those operative procedures which are life-saving. These are (1) closure of the perforation, with adequate drainage of the peritoneal cavity; (2) when this is impossible, packing and drainage down to the area of perforation, in which event a second operation becomes imperative as soon as the condition of the patient permits; (3) rarely, as will be pointed out later, the making of a jejunostomy becomes the operation of choice.

A second group comprises those patients who are seen very soon after the perforation, who are in good condition and in whom, upon

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\* Read at a Clinical Conference, Mount Sinai Hospital, January 27, 1916.



opening the abdomen, a serous exudate is found, perhaps localized to the upper right quadrant of the abdominal cavity.

Third, there is that largest group composed of patients who come to operation when the perforation is many hours or days old and who have much seropurulent or purulent exudate within the abdomen, the manifestations of the extent and severity of the accompanying peritonitis.

In these two latter groups the question of doing more at the primary operation than simple closure of the perforation arises.

Nineteen patients have been treated for acute perforation of the stomach or duodenum in the last two years, and this number includes sixteen men and three women.<sup>1</sup> The patients have all been between twenty-five and forty-five years of age. Nine of the total number died, making an immediate mortality of 47 per cent.

Most of the perforations were found near the pyloric sphincter, either in the stomach or in the duodenum, and several were found on the lesser curvature. None was found near the cardia. All of these had perforated into the general peritoneal cavity, so that at the time of operation the lesser peritoneal cavity was apparently not involved. In studying the records of these patients, the usual difficulty was always present of estimating from written descriptions the extent and severity of the accompanying peritonitis. The tissues of the stomach wall surrounding the perforation were either soft and pliable, and the stitches put in to close the perforation held very well, indicating that one had to deal with an acute perforating ulcer; or there was much induration present, and the closure became a matter of difficulty, indicating that the perforation had occurred in an ulcer of long standing.

The following table shows the length of time prior to perforation during which symptoms referable to some stomach lesion had been present:

- In 4 patients perforation was the first symptom;
- In 5 patients symptoms had been present for periods up to 6 months;
- In 1 patient symptoms had been present for 1 year;
- In 2 patients symptoms had been present for 2 years;
- In 3 patients symptoms had been present for 6 years;
- In 1 patient symptoms were present for 10 years;
- In 1 patient symptoms were present for 15 years;
- In 2 patients the history is deficient on this point.

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<sup>1</sup> There are no adequate data available at the present writing which explain this preponderance in the male sex. It is quite possible that this bears some relation to the etiological cause of ulcer of the stomach and duodenum.

## PERFORATED ULCER OF THE STOMACH

The lengths of the intervals between perforation and operation were as follows :

2 hours, 1 patient	30 hours, 1 patient
6 hours, 3 patients	36 hours, 1 patient
7 hours, 1 patient	48 hours, 1 patient
8 hours, 1 patient	72 hours, 1 patient
10 hours, 1 patient	5 days, 1 patient
12 hours, 3 patients	8 days, 1 patient
24 hours, 2 patients	unknown, 1 patient

Brief notes on the character of the treatment and the post-operative course, with the final result, are given in the following table :

Case No.	Interval after perforation	Operation	Post-operative course	Result
1	2 hours	Closure	Pneumonia developed, and on 9th day	Died.
2	6 hours	Closure and gastro-ent.	Uneventful	Well.
3	6 hours	Closure and gastro-ent.	Uneventful	Well.
4	6 hours	Closure and gastro-ent.	Uneventful	Well.
5	7 hours	Closure and gastro-ent.	Uneventful	Well.
6	8 hours	Closure and gastro-ent.	Had many other ulcers, one of which perforated on 33rd day	Died.
7	10 hours	Closure and gastro-ent.	Uneventful	Well.
8	12 hours	Closure and gastro-ent.	Uneventful	Well.
9	12 hours	Closure and gastro-ent.	Pneumonia developed, and on 7th day	Died.
10	12 hours	Closure	Died immediately	Died.
11	24 hours	Closure	Died 5 hours later	Died.
12	24 hours	Closure and gastro-ent.	Uneventful	Well.
13	30 hours	Closure	Uneventful	Well.
14	36 hours	Packed only	Duodenal leakage; later gastro-enterostomy	Died.
15	48 hours	Closure	Uneventful	Well.
16	72 hours	Closure and gastro-ent.	Death five hours later	Died.
17	5 days	Closure	Died immediately	Died.
18	8 days	Closure	Died immediately	Died.
19	Unknown	Closure	Uneventful	Well.

Comparing the interval between perforation and operation, we find that:

- Of those under 6 hours, 1 out of 4 patients died ; mortality = 25 per cent.
- Of those from 6 to 12 hours, 3 out of 6 patients died ; mortality = 50 per cent.
- Of those from 12 to 24 hours, 1 out of 2 died ; mortality = 50 per cent.
- Of those from 24 to 48 hours, 1 out of 3 patients died ; mortality = 33 per cent.
- Of those over 48 hours, 3 out of 3 patients died ; mortality = 100 per cent.

As stated before, nine of the patients died. Five of these died within a few hours after the operation. The operation in four of these

patients consisted of simple closure of the perforation, and in the fifth, of closure of the perforation with immediate gastro-enterostomy. Two of the patients died on the seventh and on the ninth days, respectively, of pneumonia. One of the patients lived for thirty-three days after the operation; the post-mortem examination showed that there were many ulcers in the stomach in addition to the one that had been closed at the primary operation, and that there was a second perforation which communicated with an abscess cavity between the stomach wall and adjacent coils of intestine. The last of these fatal cases was treated by tamponade of the perforation. A duodenal fistula developed immediately, and, although a secondary gastro-enterostomy with unilateral exclusion of the pyloric antrum was done within a few days, the patient died.

We have been much interested in the question of adding gastro-enterostomy to the closure of the perforation at the primary operation. On our service, especially when one has to deal with perforation of the wall of the stomach or duodenum, it is believed that unilateral exclusion of the ulcer-bearing area would be demanded in addition. The reasons for this are noted below.

There are many things which may be said for and against gastro-enterostomy at the primary operation. The absolute indications for the performance of gastro-enterostomy in the presence of an acute perforation are:

1. Stenosis of the pylorus or duodenum. This may result from the presence of old or recent peripyloric or periduodenal adhesions accompanying pathological lesions in the indicated portion of the alimentary canal, or in a neighboring organ, such as the gall-bladder. Such adhesions are present fairly often. The stricture may be due also to extensive scarring of the wall of the stomach, or duodenum, produced by the healing of extensive ulcerations. Lastly, in exceptional instances, the lumen of the alimentary canal at the area of perforation may be compromised by the infolding of the wall necessary to the proper closure of the opening. This latter condition is in the main theoretical, inasmuch as it is universal experience that it is impossible to produce permanent narrowing of the calibre of the intestine at any part of its course by this method.

2. To safeguard insecure stitches. One might almost say that such an indication is present in every case because the closure of the perforation is necessarily made in infected territory.

3. When the perforation is only packed or drained, gastro-enterostomy, with unilateral exclusion of the area of perforation, is the

## PERFORATED ULCER OF THE STOMACH

only safe way of preventing the formation of a duodenal fistula. The development of such a condition (and if nothing is done for its prevention it will almost invariably develop) is a most serious and, in the greatest majority of the cases, a fatal lesion.

This condition was well illustrated by the following case: During the course of an operation for a perforated ulcer on the anterior surface of the duodenum, several unsuccessful attempts were made to close the opening. The condition of the patient becoming exceedingly desperate, nothing further was attempted, and the perforation was packed. A duodenal fistula resulted, and the condition of the patient deteriorated steadily. On the eleventh day a gastro-enterostomy was hastily done with a Murphy button and the perforated area was excluded by the string method. No further leakage occurred but, nevertheless, the patient succumbed some days later.

These are indications which can be met satisfactorily in no other way than by the performance of gastro-enterostomy with unilateral exclusion of the involved area. If, owing to the desperate condition of the patient, the gastro-enterostomy may not be done immediately, it will become imperative within a very few days, especially if duodenal leakage should develop. After such a delay the general condition of the patient becomes all the more compromised.

Gastro-enterostomy also offers the following advantages:

1. It facilitates the early nutrition of the patient.
2. It exerts a favorable influence upon the underlying ulcerated condition. Eliot<sup>2</sup> was able to collect seventy-five cases in which symptoms of ulcer continued after the recovery from the operation for acute perforation, and gastro-enterostomy had to be added later.
3. It diminishes the danger of subsequent hemorrhage or perforation in coexisting ulcers and favors their healing. There are records in the literature<sup>3</sup> of twelve patients in whom perforation occurred for a second time from other coexisting ulcers after the primary operation.

Objections that are made to the addition of gastro-enterostomy at the primary operation are:

1. It prolongs the operation and adds to the shock. In skilled hands, however, an anastomosis with the Murphy button can be made in ten minutes, or even less. However, as said before, the desperate cases are not considered as coming in the class of cases in which the question

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<sup>2</sup> Eliot: *ANN. SURG.*, Philadelphia, 1912, 55, 689.

<sup>3</sup> Brunner: *Deutsch. Ztschr. f. Chir.*, 1903, 69.

of making a gastro-enterostomy arises. In the group under discussion the added ten minutes would not appreciably alter the final outcome.

2. It spreads infection to uninvolved portions of the general peritoneal cavity and into the lesser peritoneal sac. This objection is theoretical. In actual practice it is found that this rarely if ever occurs.

3. Gastro-enterostomy is not necessary because, in the first place, it does not always cure the underlying condition; and, in the second place, patients recover from the ulcer without it. The same objection could very properly be made to the procedure when applied as a curative measure for non-perforated ulcers, but, nevertheless, our statistics show that the best results are obtained with this method of treatment. Our studies further go to show that many of the so-called recurrences after operation for ulcer of the stomach or duodenum are due to other causes than the original ulceration.

4. The performance of a gastro-enterostomy at the primary operation adds to the mortality. Of those in our series, nine died; of these, three had had a gastro-enterostomy made at the primary operation. Of these three, one died of shock, one of pneumonia on the seventh day, and the third died on the thirty-third day from perforation of a coexisting ulcer. Another of the fatal cases, the one which had been treated primarily by packing, might have been saved if an immediate gastro-enterostomy had been made.

Taking the cases all in all, we found:

Of 8 patients treated by simple closure, 5 died; mortality = 62 per cent.

Of 10 patients treated by closure and immediate gastro-enterostomy, 3 died; mortality = 30 per cent.

Of 1 patient treated by tamponade, 1 died.

For the sake of controlling these percentages, they are also compared with those obtained by tabulating all of the patients operated upon in the first twelve hours after perforation. There were two patients whose perforation was treated by closure alone; both of these died. There were eight patients in whom, in addition to the closure, a gastro-enterostomy was made; two of these died.

In any individual case the question of adding gastro-enterostomy immediately must be decided at the moment of operation by the findings in the abdomen and by the general condition of the patient. Excluding the moribund cases, we believe that gastro-enterostomy is a most valuable procedure, not only as a help in securing the closure of the perforation, but also as a measure directed towards the underlying condition.

## PERFORATED ULCER OF THE STOMACH

*Jejunostomy.*—In a few patients jejunostomy will be indicated. When the ulcer which has perforated is high up near the cardia in an inaccessible location, or in those conceivable cases when it is impossible to find the perforation, or the condition of the patient does not permit an extended search, the indication is to exclude and put at rest the entire stomach and duodenum, and this is best done by jejunostomy and jejunal feeding. Cases are also met in which large perforating ulcers are found on or near the greater curvature, in the general region in which it is proper to make a gastro-enteric anastomosis, and in which the presence of extensive adhesions precludes the possibility of making a gastro-enterostomy. In such cases the condition of the patient and the local conditions prevent the excision of the ulcer area. In these cases, too, jejunostomy is indicated, and it practically becomes a matter of necessity.

Excision of the ulcer-bearing area in the presence of an acute perforation is a very dangerous procedure and is rarely, if ever, called for. It would find its chief indication in the acute perforations of carcinomatous ulcers.

# A REPORT OF NINE CONSECUTIVE OPERATIONS FOR PERFORATED GASTRIC AND DUODENAL ULCERS

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THE series of cases here reported was operated upon by Dr. Philip W. Bill and the writer, at The Bridgeport Hospital, between February, 1915, and March, 1916. All of the cases recovered, and I have accurate information from 7 cases as to their condition since operation.

For convenience of study, we have classified our cases into three divisions, acute, subacute and chronic. Seven of our cases were acute, in that the perforation occurred suddenly with a flooding of the peritoneal cavity with gastric contents. One was subacute, in that the perforation occurred suddenly, but the stomach being empty at the time, the symptoms were less intense, for the patient walked many miles after the development of symptoms, and at operation the opening was found to be partly occluded by plastic adhesions. The chronic case showed very few symptoms suggestive of perforations, and at operation a subphrenic abscess was found.

*Sex.*—All of our cases occurred in males, the youngest being nineteen years of age, and the oldest fifty-six years. In each case the *perforation* was single, but that does not mean there were no other ulcers present.

*Situation.*—In 5 cases the ulcer was situated on the anterior surface of the stomach, in 3 on the first portion of the duodenum, and in 1 on the posterior surface of the stomach.

It was observed that the perforation occurred within one inch of either side of the pyloric valve in every case.

The explanation of the decided frequency of perforations situated on the anterior surface lies in the added liability of this surface to trauma, its greater mobility, and the fact that protective adhesions are less easily formed.

*Diagnosis.*—When seen early, the diagnosis is easy. In 8 cases we were able to make a positive diagnosis before operation.

The most pronounced and characteristic symptom was pain in the abdomen. It differs from the pain of appendicitis, in that it is sudden, violent and continuous. In appendicitis the pain gradually increases in

severity, and is worse at the end of an hour than it was at the beginning. The abdomen was flat, retracted and the rigidity board-like. The facial expression showed great distress, and the respirations were rapid and shallow.

In 5 cases the patient vomited, but this greatly increased rather than lessened the distress. Six patients gave a history of gastric disturbance, 3 gave no history of gastric trouble whatever.

In 4 cases we were able to demonstrate perfectly Claybrook's sign, namely, the heart and pulmonary sounds were transmitted to the abdomen, and there heard plainly.

*Operative Procedure.*—All of our cases were given ether. We have found it advantageous to give a preliminary injection of atropine, gr.  $\frac{1}{150}$ .

On opening the peritoneal cavity, in 6 cases, the preliminary diagnosis was confirmed by an escape of gas, or foul-smelling, yellowish fluid. When the perforation was found the opening was cauterized with the actual cautery, a purse-string inserted, which, when drawn tight, readily closed the opening.

In all cases drainage was provided. When there was considerable escape of fluid, the pelvis, as well as the local site of perforation, was drained.

Contrary to the procedure of many operators, we have not attempted the performance of immediate gastro-enterostomy, because, in our opinion, the added shock would prove detrimental in many cases, and also because we feel that many cases of gastric ulcer recover after perforation. It is noteworthy that the majority of our patients have remained free from subsequent gastric disturbance after treatment.

For the first twenty-four hours saline or tap water, one pint every three hours, is administered. On the second day, broths and water are given by mouth. Solids are gradually added, and by the seventh day the patient is receiving regular hospital diet.

Drains are removed as soon as possible. At the end of two weeks the patient is allowed to sit up, and is discharged two days later.

A brief résumé of the cases is as follows:

CASE I.—Mr. M. C., aged forty years. History of gastric disturbance for past five years. Seized very suddenly one morning with severe pains in abdomen. Diagnosis of ruptured ulcer made. Immediate operation. Perforated ulcer on anterior surface of stomach found; closed by purse-string suture; drainage over site of perforation; left hospital sixteen days later. Three months later patient had a return of gastric disturbance; X-ray showed an ulcer of duodenum. Posterior gastro-enterostomy was performed.



One year after patient reports he is feeling exceptionally well and has gained thirty pounds in weight.

CASE II.—Mr. J. Q., aged thirty-six years. No previous history of gastric disturbance. While eating his supper he was seized with severe cramps in epigastrium; a ruptured ulcer was diagnosed. Operation revealed perforating duodenal ulcer that was closed in the manner described. Discharged fifteen days after operation. A communication nine months afterward reports freedom from any gastric disturbance, and a slight gain in weight.

CASE III.—Mr. I. B., aged forty-nine years. History of gastric distress dating back two years. Seized suddenly after eating with terrific abdominal pain. House surgeon on his admission diagnosed ruptured gastric ulcer. Operation showed perforated ulcer on anterior surface of stomach; closed by purse-string suture. Made an uneventful recovery. Since operation he has remained free from any stomach disturbance.

CASE IV.—Mr. W. J., aged twenty-seven years. No history of any previous gastric complaint. Was transferred from medical to surgical service for operation for a supposed gall-bladder condition. A subphrenic abscess was found containing a *real* orange seed. On the posterior surface of stomach there was a thickening and numerous adhesions, leading us to conclude that perforation occurred here several days before operation. We have not heard from the patient since he left the hospital.

CASE V.—Mr. Z., aged eighteen years. No previous gastric disturbance. While on a long walk he was seized with a dull pain in abdomen, not severe enough to compel him to give up. Increasing in intensity he sought hospital treatment twelve hours after the pain began. A ruptured gastric ulcer or high appendix was the pre-operative diagnosis. Perforated ulcer on anterior surface of stomach was found. Fourteen days afterwards patient left hospital in good condition. No report as to his condition since leaving hospital is at hand.

CASE VI.—Mr. O. F., aged fifty-six years. History of gastric distress extending over a period of nine months. While at work was taken violently ill with pain in abdomen; removed to hospital at once; diagnosis of ruptured ulcer made. At operation opening was found on anterior surface. Patient made a speedy recovery, leaving the hospital twelve days after operation. A recent communication states that he is free from any gastric disturbance, and is steadily gaining in weight.

CASE VII.—Mr. P. B., aged forty-two years. No previous history of any gastric trouble whatever. While on a drinking debauch was taken ill with severe abdominal pains. On admission to hospital, a diagnosis of ruptured ulcer was made. At opera-

tion a ruptured duodenal ulcer was found, which was closed in the manner described. Patient left the hospital well three weeks later. Two months after operation finds him at work, free from distress and gaining in weight.

CASE VIII.—Mr. G. L., aged twenty-eight years. For past three months he has complained of distress after eating. While working at his bench, he was seized with abdominal pains, so severe that when the ambulance arrived he was in shock. A diagnosis of ruptured ulcer was made, and confirmed by operation, the site of perforation being the duodenum. Owing to the development of pelvic peritonitis his recovery was protracted. A recent communication shows that he has gained twenty pounds in weight and has remained free from any stomach distress.

CASE IX.—Mr. J. G., aged forty-three years. Long history of gastric disturbance after eating. After a hearty meal was seized with pain in abdomen, so severe that he immediately sought hospital treatment. Perforated gastric ulcer was diagnosed. Operation showed the anterior surface of stomach to be the site of perforation. His recovery was rapid and uneventful. Word from his physician states him to be in better health than he has been for years, and free from the distress he so long complained of.

# RUPTURE OF THE COMMON BILE-DUCT ASSOCIATED WITH SUBPHRENIC ABSCESS

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FELLOW, MAYO CLINIC

IN a thorough review of the literature on ruptures of the common bile-duct, I was able to bring to light but 7 cases beside the case reported herein.

JANEWAY<sup>1</sup> in 1887 described a case which came to necropsy. A stone was found obstructing the common duct, causing suppuration, dilatation and perforation of all three ducts. The pyloric end of the stomach, duodenum and transverse colon were all adherent to the under surface of the liver. Upon removal of the liver a subdiaphragmatic abscess was discovered. The patient had given a history of a gall-stone colic of fourteen years' duration, with accompanying jaundice and the passing of calculi on several occasions. The terminal illness, a typical gall-stone attack, began one week before death. A very sharp abdominal pain occurred forty-eight hours before death, probably at the time of perforation.

McWILLIAMS<sup>2</sup> collected and reviewed 114 cases of perforation of the biliary system, of which four were perforations of the common duct. One of them (Kehr's case) was that of a woman aged fifty-one years, who had had symptoms for four days, accompanied by jaundice. A cholecystectomy was done but the patient died. Calculi in both the common and hepatic ducts and perforation of the common duct were found at necropsy. The second case, reported by Riedel, was that of a man aged fifty-six years, with symptoms of three days' duration. A cholecystostomy was done, but the patient did not recover. Necropsy revealed a calculus in the common duct with accompanying perforation. The third case was reported by Routier and was that of a woman aged fifty-six years, with symptoms of only one day's duration. Operation revealed free bile and a perforation of the common duct. The gall-bladder and peritoneal cavity were drained and the woman recovered. At a second operation (cholecystectomy) multiple stones in the gall-bladder and ducts were found. The fourth of this group was Neupert's case; a woman aged forty-three years, with symptoms of fourteen hours' duration, with jaundice. A rupture at the juncture of the cystic and common duct and an impacted stone in the common duct were found at operation (cholecystectomy). The patient made a complete recovery.

CAMPBELL-HORSFALL<sup>3</sup> has reported a case in detail. His patient, a woman aged forty-five years, suffered with dyspepsia and spasmodic epigastric pain for years. Following one of these attacks of unmistakable gall-stone colic, she was seized with intense pain in the upper abdomen and chest. When first seen she was in a state of complete collapse. Operation was performed the following day. On opening through a right rectus incision, bile-stained fluid and pus welled up. The gall-bladder was shrunken and the fluid could be traced to the common duct. A rubber drain was carried down to the common duct and a

## RUPTURE OF THE COMMON BILE-DUCT

cigarette drain placed in the right kidney-pouch. The pelvis was also drained through a stab-wound. Two weeks later an accumulation of biliary matter was drained through a second stab-wound in the left flank. The patient made an uneventful recovery. Campbell-Horsfall feels that this case is of interest as demonstrating the urgency and success of early operation. He cites the four preceding cases and points out that in those reported by Riedel and Routier, in which operative procedures were instituted early, recovery resulted; the other two, in which operative procedures were delayed, ended fatally.

LAPENTA<sup>4</sup> reports one case. A woman, aged sixty-nine years, was seized with excruciating epigastric pain followed by vomiting and coma. There was no history of previous gall-stone attacks. At operation the following day the gall-bladder was not distended. The lesser peritoneal cavity contained bile and bloody serum. There was a perforation 8 mm. in length in the common duct just below the entrance of the cystic duct from which a calculus was protruding. This and several smaller stones were extracted, a cholecystostomy being done. A cigarette drain was placed to the point of rupture. Recovery was uneventful. Lapenta lays great emphasis on the coma, believing it to be diagnostic of rupture of the common bile-duct. It is of interest in this connection to note that Campbell-Horsfall reports his patient as unconscious when first seen.

MEISSNER<sup>5</sup> has reported 12 cases but all were traumatic in origin and, therefore, will not be considered in this paper.

The history of our own case is as follows:

Mrs. A. P., a married woman aged forty-four years, came to the Mayo Clinic January 24, 1916. Her family history was negative and the only sicknesses she could recall, save those directly connected with her present trouble, were grippe and tonsillitis, fourteen years before, and an occasional attack of rheumatism. She had been pregnant six times. Four children were living, the oldest twenty-five, the youngest seven. Two were born before full term, and lived but a few weeks. During her first pregnancy, twenty-four years before, she had several attacks of severe cramp-like pain below the right costal margin. Two years later, during her second pregnancy, the severity and frequency of these attacks increased and on several occasions were accompanied by jaundice requiring two to three weeks to clear. Six months after this pregnancy she had a very severe attack with extremely deep jaundice. During her third and fourth pregnancies she had frequent recurrences of this trouble, and during her fifth pregnancy she had as many as nine to ten attacks of gall-stone colic. Since then, *i.e.*, for the past fifteen years, although she has had frequent and varied attacks, they have never been accompanied by jaundice. On several occasions she has passed calculi by bowel. Three months previous to her present trouble she had an attack lasting twenty-four hours, during which she vomited a great deal of bile-stained material. On December 25, 1915, about 7 o'clock in the evening, the patient experienced con-

siderable upper abdominal discomfort. This became progressively worse, and at 10 o'clock the pain was so severe that she took a quarter of a grain of morphia for relief. At first, as in all the previous attacks, the pain was felt along the right costal margin radiating through to the right shoulder-blade. At six o'clock of the morning of the second day, she was seized suddenly with a sharp pain in the right lower quadrant, so severe that in spite of the fact that she had taken another quarter of a grain of morphia, it forced her to cry out with every breath. During the night she had three bowel movements. The next morning, however, the family physician could not get any results, either gas or fecal, with enema. The low abdominal pain continued for two and one-half days. One week after the onset of the attack a severe burning pain developed in the base of the right chest and at the same time a swelling slowly appeared in the right lower quadrant. This continued to grow in size and her condition became worse until January 24, when she was examined in the Mayo Clinic.

The patient was emaciated and weak, requiring assistance to get about. A slight yellow tinge was noted in the sclera. Pulse 120; temperature 101°. She had a short irritating cough and was unable to take a deep breath because of pain. The chest showed dulness and absence of breath sounds at the right base. The abdomen was very tender and rigid over the region of the gall-bladder. A large mass could be palpated below the right costal margin, extending along the nipple line to the crest of the ilium. The urine was acid and contained a trace of albumen; specific gravity 1017. White blood-cells, 17,600. Radiologist's report: Increased density in the lower right chest to the level of third rib in front. Diaphragm appeared to be above the mass.

*Operation.*—On January 26, a diagnosis of subdiaphragmatic abscess and acute inflammation of the gall-bladder having been made, an operation was performed under local anæsthesia (Judd). Temperature 100.4°; pulse 120. Through a stab incision in the right flank, a blunt dissection was made forward outside the peritoneum to the point of adhesion between the abscess-mass and the abdominal wall. Through an opening here two to three quarts of turbid, greenish yellow, somewhat purulent, odorless fluid and numerous calculi escaped under considerable pressure. A large rubber-tube drain was inserted and the patient placed in bed. The abscess cavity drained biliary detritus for seven days; the temperature and pulse returned to normal. Although still quite weak, the patient was up on the tenth day and gained rapidly until the night of the thirteenth day, when she was seized with an attack of typical gall-stone colic. The pain, which was

## RUPTURE OF THE COMMON BILE-DUCT

very severe, began below the right costal margin, radiated through to the back and was accompanied by nausea and vomiting. Her condition showing no improvement the next day, February 10, a second operation was performed, through a modified Bevan incision. There were many adhesions and the tissues were all very much indurated. The gall-bladder was tense, cystic and shrunken; the mucous membrane, though almost completely destroyed, still retained clear cystic fluid with numerous stones, but no bile. Some of the stones were impacted in the cystic duct, completely obstructing it. The abscess which had been drained two weeks previously was found to be subphrenic, there being a large pocket in the right anterior subphrenic space. With the operating field clear of old clots and adhesions, bile was found leaking from a point high on the common duct, just at the juncture with the cystic duct. There were also two stones obstructing the common duct, one stone presenting at the perforation.

Cholecystectomy and choledochotomy were done and a Robson hepatic drain was placed in the common duct. The subphrenic abscess was well sponged out and packed with three strips of iodoform gauze and a split tube. A second split tube and gauze were placed so as to drain the stump of the cystic duct. The wound was closed in the usual manner, and before the patient was taken from the table bile was flowing freely from the Robson tube.

The patient's convalescence was uneventful, save during the third and fourth days, when nausea and vomiting were very annoying. Gastric lavage every six hours overcame this complication, although for several hours the pulse was 130. On the sixth day, while the gauze was being shortened, the Robson tube came out. All of the gauze was removed on the eighth day, and the rubber tubes on the thirteenth and fourteenth days, respectively. At this time the patient was out of bed. Three days later, when she left the hospital, all bile drainage had ceased, although a small sinus persisted.

Moynihan<sup>o</sup> states that the cardinal symptoms of rupture of the common bile-duct are: Jaundice, absence of bile in the stool, gradual distention of the abdomen and wasting. The jaundice, he points out, is never intense, but is rather a yellow tinge in the skin or a slight yellowing of the sclera, as in the case reported here. This is because the bile is only slightly absorbed by the peritoneum after the first inflammatory exudate is set up and because there is no retention of it in the liver. For the same reason the bile in the urine is slight. The stools are always clay-colored, for all the bile escapes from the rupture,

none entering the intestine. A constant feature is the gradual distention of the abdomen. This may be general, due to the flow of the bile over the entire abdominal cavity, but more commonly is confined to one part as a local swelling, generally in the right hypochondrium, as in our case. A rapid loss of flesh is always noted, and emaciation and weakness may be extreme; our patient lost 20 pounds in a little over two weeks. The typical pathologic condition is an inflammatory softening and distention of the walls due to the obstruction of the duct with a final ulceration and giving way of the tissues. The rupture may occur into the general peritoneal cavity, but by the aid of protective adhesions a localized abscess is generally formed.

Riedel<sup>7</sup> reports two cases in which a localized abscess resulting from rupture of the cystic duct had involved and perforated the common duct.

The foregoing 8 cases follow closely the symptoms and pathology given by Moynihan. They also demonstrate the benefit to be derived from early operation, preferably in two stages. The first stage, which consists of drainage, enables the patient to undergo the second and more extensive operation with far less risk.

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# ANOMALIES OF THE GALL-BLADDER AND BILE-PASSAGES

WITH THE REPORT OF A DOUBLE GALL-BLADDER AND A FLOATING GALL-BLADDER

BY AUGUST SCHACHNER, M.D.

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ABDOMINAL surgeons of to-day, and more especially of the future, will hardly be content with a general knowledge of the anatomy of the abdominal viscera.

Refinements in operative and diagnostic technic will demand a detailed knowledge of the anomalies in whole or in part of abdominal organs.

In view of this forecast, it behooves us to investigate and more fully report the various anomalies as they present themselves.

To this end there should be a closer coöperation between the operating room, the anatomic laboratory, and the pathologic laboratory, in order that definite data may at an early period be recorded, indicating the possible frequency of the various anomalies.

This paper is based upon an inquiry into the literature, present and past, and an exchange of communications with a number of surgeons and hospitals. I wish to publicly record my thanks to the various surgeons and hospitals for their answers to my communications.

The inquiry developed the fact that practically no additional material was acquired through these communications. That this result is misleading, there can be but slight doubt, and the fact that one operator (Kehr) who follows somewhat different lines and with different results, so far as anomalies are concerned, strongly supports this view.

The array of anomalies presented by Kehr stands alone both as to number and variety. This exceptional collection is partially explained through Kehr's statement, that a more thorough search should be undertaken at the time of operation and that the operative procedure should be carried out through a larger incision, or at least an incision yielding a more accurate survey of the field of activity. He condemns what he calls "the button-hole incision," so commonly employed in American surgery.

We feel inclined to add that the result of the correspondence left us convinced that inadequate incisions do defeat an accurate survey, and that many valuable findings have been lost in the past through the absence of proper search and a suitable system of recording the anomalies that were revealed.



It may be well to say that this paper is restricted to congenital anomalies, and not to malformations resulting from pathological processes. Further, many reports encountered, in examining the literature, were rejected because they were so obviously deficient in definition, or so apparently due to pathological processes, that their value as reports was hardly justified. No effort was made to study the vascular anomalies attending the blood supply of the liver, gall-bladder, or bile passages.

In many instances it was shown in the cases reported, that anomalies in this region follow the rule of anomalies elsewhere in the human subject, namely, in not occurring singly, *i.e.*, an anomaly of the gall-bladder may have an attending anomaly of the ducts or the blood supply, or some other part of the hepatic system. This is especially noticeable in the properly conducted post-mortem examinations, where the investigations could be carried out in detail, a privilege often denied during a surgical operation.

When the development during the embryological period is disturbed, this disturbance is usually not of an isolated nature.

## SYNOPSIS

## ANOMALIES OF GALL-BLADDER

Anomalies relating to gall-bladder cavity . . . . .	Double gall-bladder.
	Bilobed gall-bladder.
	Diverticulum of gall-bladder.
Anomalies relating to location of gall-bladder . . . . .	Intrahepatic gall-bladder.
	Left-sided gall-bladder.
	Transposition of viscera.
	Floating gall-bladder.
Individual anomalies . . . . .	Absence of gall-bladder.
	Hour-glass gall-bladder.

## ANOMALIES OF BILE PASSAGES

- (1) Double cystic duct.
- (2) Anomalies of hepatic ducts.
- (3) Absence of common duct.
- (4) Anomalies of common duct.

*Double Gall-bladder.*—To come under the above classification, each gall-bladder should have its independent cystic duct, thus differentiating it from a bifid gall-bladder in which the cavities are distinctly separate, but communicate with the common duct through a single cystic duct.

CASE I.—Dr. Purser exhibited a liver with two gall-bladders. It was taken from a girl aged eleven, who had lately died of malignant scarlatina in Sir Patrick Dunn's Hospital. At the postmortem, besides the ordinary changes caused by the disease, two separate gall-bladders were found, each of which had a distinct cystic duct; and these opened into the bile duct, the one at some distance from the other. There were no marked anomalies in the liver except that the common hepatic duct, instead of dividing into two branches when coming into the

## ANOMALIES OF THE GALL-BLADDER AND BILE-PASSAGES

liver, divided into three, one to the left, another to the right, and a third running into the posterior part of the liver. These ducts did not communicate with one another, but were distinct in their whole course.

CASE II.—Dr. Purser (*British Medical Journal*, 1886, vol. ii, p. 1102) was indebted to Dr. Foot for a case recorded in the Philosophical Transactions. The subject was a lady aged thirty-one, who for some time before her death had suffered from loss of appetite, vomiting and pain. At the post-mortem examination, her lungs were found to be in a state of commencing phthisis. The spleen was smaller than usual, but the liver was so large that it occupied the left hypochondrium as well as the right; there were strong adhesions on both sides; there were two gall-bladders, both distended with bile, one in the right and the other in the left lobe of the liver.

CASE III.—The existence of the double gall-bladder was not recognized until the peritoneal covering was removed. Then it was apparent that the gall-bladder was double from the fundus to the neck.

There were two cystic ducts, the one communicated with the hepatic duct. The second subdivided into two subdivisions. The course of one subdivision was unavoidably lost, and that of the other subdivision communicated with the common duct. The points in the case are double gall-bladder with a single neck and two cystic ducts. (Cruveilhier, E.: *Bul. Soc. Anat. de Paris*, 1860, xxxv, p. 66.)

CASE IV.—On opening the abdomen through the right rectus muscle, I found a distended gall-bladder which I could not empty. On tracing the cystic duct downward to discover the cause of the obstruction, I came upon a firm nodule, which I took at first to be a calculus. As it was apparently firmly impacted, I cut through the peritoneum covering the duct and discovered that the supposed calculus was a thickening in its wall about three-quarters of an inch from its junction with the common bile duct. I ligatured and divided the duct and then found that I could not strip up the gall-bladder in the usual way, and the duct tore just above the nodule in the attempt. On further dissection I found another duct which I ligatured and divided, covering the stump with peritoneum, and closed the belly.

On examining the specimen (now in the Museum of the Royal College of Surgeons of England, No. 561.31), the ducts were at once evident and closer examinations revealed another sack above and completely concealed by the distended lower one. On section two complete gall-bladders were evident, joined only along a narrow portion of their circumference. The larger one contained thick bile-stained mucus, the smaller thin bile. On examining the portion of the cystic duct belonging to the larger gall-bladder, I found it patent at its common duct end; at the site of the nodule, its lumen was a little increased in size and ulcerated, as if from the lodgement of a calculus. Above this it appeared to be obliterated. (Sherren: *ANNALS OF SURGERY*, vol. liv, p. 204.)

CASE V.—Author's case of double gall-bladder. Miss G., aged fifty-two, of Simpsonville, Ky., was referred to me through the kindness of her physician, Dr. Joseph Perrin, of the same place. She had been a sufferer from gall-stone colic and dyspepsia for the last 15 or 20 years.

*Operation.*—At the Jewish Hospital, March, 1914. Incision right semilunar line. On exposing the gall-bladder, a raphé was

evident, passing from the fundus to the neck and dividing the gall-bladder surface into two unequal halves. A mesentery existed, which also passed from the fundus to the neck. The inner blade of this mesentery became lost in the peritoneal covering of the duodenum; the outer blade was reflected over the hepatic flexure of the colon with which it became merged. The mesentery, which measured about 6 cm. from its central to peripheral borders, was freed from the gall-bladder, permitting of easy access to the same. The unequal division of the surface was at first thought to be the result of former inflammatory attacks. On opening the gall-bladder, the error of this conclusion became evident. The gall-bladder was plainly a double one, with stones in each gall-bladder. After draining these and removing the stones, a careful examination was conducted to more fully determine the exact arrangement. The result of this was a double gall-bladder, each with its independent neck and, so far as we were able to determine, two cystic ducts. Both gall-bladders were drained, the patient making a satisfactory recovery, which has continued.

*Bilobed Gall-bladder.*—A gall-bladder, the cavity of which consists of two lobes communicating with the common duct through a single cystic duct.

CASE I.—The gall-bladder was bilobed. The greater lobe being discolored, and almost gangrenous at its lower portion. This lobe contained one calculus. The other lobe seemed to be normal. There was only one cystic duct draining both lobes. It was patulous. (Deaver and Ashhurst: vol. ii, p. 42.)

*Diverticulum of Gall-bladder.*—A gall-bladder consisting of one large cavity and one or more smaller cavities or recesses communicating with the larger or true gall-bladder.

CASE I.—The gall-bladder was distended and full of calculi of various sizes. The neck of the gall-bladder just above the cystic duct was pouched in such a way as to form a sack which pressed upon the common duct and caused obstructive jaundice. (Deaver and Ashhurst: vol. ii, p. 42.)

CASE II.—Kehr (vol. i, p. 127) reports a diverticulum of gall-bladder filled with stones and in the same case the common duct divided just beyond the entrance of the cystic duct into two divisions.

CASE III.—Kehr (vol. ii, p. 291) reports another case of diverticulum together with unusual vascular anomalies and pathology.

AUTHOR'S COMMENT.—The operation lasted one hour and it is remarkable that so much vascular anomaly and pathology could be revealed and cared for in one hour, even though the incision was a free one.

CASE IV.—Macroscopic appearance: The gall-bladder on its inner surface, near the fundus, presented an enlargement of an oval shape. The maximum measurement in length was 15 mm. The maximum measurement in breadth was 8 mm. The highest point above the surrounding surface was 3 mm. An opening into this 1 mm. in width was present.

## ANOMALIES OF THE GALL-BLADDER AND BILE-PASSAGES

CASE V.—Macroscopic appearance: The wall of the gall-bladder measured 6 mm. in thickness. This thickness was made up of distinct lamellæ, much like in structure to that of a thrombus. The peritoneal covering is also thickened. On the inner surface of the gall-bladder, a wedge-shaped opening 8 mm. in length was observed. This cavity was lined throughout by mucous membrane.

CASE VI.—Macroscopic appearance: In the fundus of the gall-bladder there was a funnel-shaped excavation. The surrounding edges of this cavity were 3 mm. in thickness and 4 mm. in width. In this case the microscopic examination proved this to be adenomatous in character. (Herman Weltz, Kiel: Ueber Divertikel Der Gallenblase.

CASE VII.—Diverticulum of gall-bladder occurring in a child one year of age. The compartment occurred near the fundus. The dividing septum occupied a transverse position and measured 2 mm. in thickness. The septum was 8 mm. in distance from the fundus. (Dév  : Bul. Soc. Anat., Paris, 1903.)

### ANOMALIES RELATING TO LOCATION OF GALL-BLADDER

*Intrahepatic Gall-bladder.*—A gall-bladder partly or entirely imbedded in liver substance as opposed to merely occupying the classical gall-bladder depression on the under surface of the liver.

All degrees of this condition may occur from a small bridge of liver tissue passing across from the quadrate to the right lobe to complete submersion of the gall-bladder so that no trace of it is discernible from the outside. The latter condition is the only one which would be confused with a misplaced or absent gall-bladder, but in this degree it is extremely rare. According to D  v   the gall-bladder is only truly intrahepatic in infancy. Later on in life the covering of the liver tissue atrophies on the under surface and the gall-bladder becomes exposed. There is a case recorded by Lemon where the fundus of the gall-bladder alone projected and in which gall-stones were present (Walton).

D  v   speaks of the arrangement in reptiles, in which the gall-bladder is almost completely buried within the liver substance. He expresses surprise that the intrahepatic arrangement has not attracted more attention. The existence of intrahepatic gall-bladder was marked through a difference in color, the yellowish or greenish color of the gall-bladder being in striking contrast to the reddish-brown color of the liver substance; as a further guide, the topographic elevations of the overlying liver substance. D  v  , in a study of 130 livers of infants, discovered 11 instances of intrahepatic gall-bladder, 3 were typical and in 8 the fundus alone was more or less imbedded; no intrahepatic condition was noticed in adults.

To the case of Lemon may be added 4 cases observed by Kehr (vol. i, p. 116), making a total of 16 intrahepatic gall-bladders.

*Left-sided Gall-bladder.*—One occupying a position to the left of the falciform ligament in a normally placed liver.

CASE I.—The present specimen I wish to report was obtained from an anatomical subject, a full-time female f  etus, in the Anatomical School of the London

Hospital. The history of the cause of death was naturally difficult to obtain, but as far as could be ascertained, this took place in prolonged labor. The gall-bladder was situated on the left lobe, but is normal in shape and attachment. The neck of the bladder is directed towards the right instead of towards the left side, and there is a well-marked Hartman's pouch just before the origin of the cystic duct. The fundus reaches to but does not project beyond the free margin of the liver. The gall-bladder lies well to the left of the umbilical vein, but the area between it and the structures which presumably should be called the quadrate lobe, is small, so that in life the gall-bladder lay close to the falciform ligament and was, when viewed from the right side, wholly covered by this structure. If, therefore, symptoms of disease of the gall-bladder or some neighboring structure had arisen which necessitated exploration through the usual incision, traversing the right rectus, the gall-bladder would at operation have been invisible, and even if the liver had been pulled well over to the right, it would have remained hidden beneath the falciform ligament which would have been stretched across it.

The difficulty which would arise at operation with such a condition would be to discover the gall-bladder, and it would be necessary, if the under surface of the right lobe were free from adhesions and visible, to distinguish it from the three following conditions; extreme fibrosis and atrophy of the gall-bladder after inflammation, complete congenital absence of the gall-bladder, and an intrahepatic gall-bladder. (Walton: *Lancet*, 1912, p. 925.)

CASE II.—A case of left-sided gall-bladder occurred in a child ten years of age, at the Hospital Trousseau, in which there occurred an abnormal arrangement of the caudate and quadrate lobe, together with a gall-bladder attached to the left lobe of the liver.

CASE III.—The gall-bladder was not only left-sided, but was situated obliquely in its relationship to the liver. This occurred in an adult.

CASE IV.—Another case likewise in an adult, in which the neck of the gall-bladder was attached to the left lobe of the liver but the fundus and body detached, was described as a case of ectopia of the gall-ladder. (Dévé *Bul. Soc. Anat.*, Paris, 1903.)

CASE V.—Hochstetter refers to a single case of left-sided gall-bladder mentioned by Huschke. Huschke's case was that of an eighteen-month-old child, in which the gall-bladder, otherwise normal, was situated to the left side and practically covered by the ligamentum teres.

CASE VI.—Left-sided gall-bladder and transposition of the umbilical vein to the right. This case was that of an adult. There was an absence of the lobus quadratus and the presence of a left-sided gall-bladder. The gall-bladder was located to the left of the ligamentum teres, with a small area of liver substance between the gall-bladder and the ligaments. Circulatory anomalies were present in this case.

CASE VII.—Recently born infant. The gall-bladder located to the left of the ligamentum teres and an absence of the lobus quadratus. In addition, in this case, the left lobe exceeded in size the right lobe of the liver. In this, as in the former case, there was an anastomosis between the umbilical and portal vein.

CASE VIII.—Body of an adult in which the gall-bladder was located immediately to the left of the ligamentum teres. The venous arrangement was practically normal.

CASE IX.—Body of an adult. In this the right and left lobes were about an

## ANOMALIES OF THE GALL-BLADDER AND BILE-PASSAGES

equal size and the quadrate lobe was absent. The gall-bladder was located to the left of the ligamentum teres.

CASE X.—A child, eighteen months old. The quadrate lobe was absent and the gall-bladder was located immediately to the left of the ligamentum teres. (Hochstetter, Ferdinand: Archiv f. Anatomie und Physiol., 1886, p. 369.)

CASES XI and XII are represented by two cases referred to by Kehr, vol. i, p. 119.

CASE XIII.—See Case II, Double Gall-bladder. In this the gall-bladders were widely separated, one occupying the right and the other the left lobe of the liver.

*Transposition of Viscera.*—In this condition the liver not only occupies the left instead of the right hypochondrium, but there is a reversal of the lobes, the left being larger than the right, and receives the gall-bladder.

Last, there is a dextro-position of the heart as well as reversal of duodenum and stomach, which becomes our most important diagnostic aid in verifying our suspicions regarding the visceral transposition and disturbances that might arise in a gall-bladder so situated.

CASE I.—A left rectus incision was made. The gall-bladder was readily accessible. Its walls were thickened, but free from adhesions. About 70 c.c. of greenish black bile was aspirated and the gall-bladder was incised. Four mulberry stones, the size of a pea, were removed. The ducts were freed. The gall-bladder was drained. The anomaly of transposition of the viscera was verified. The patient did not bear the anæsthesia well and a hasty closure was made. An uneventful recovery followed. (Horn: Situs Viscerum Inversus with Gall-stones. ANNALS OF SURGERY, vol. lxii, p. 425.)

Horn refers in his paper to cases by Beck, Fenger, Kehr, Hupp, and Bland Sutton, in which the reports definitely refer to the verifications of the condition through operation. There are two other cases in Horn's report, one by Billings, in which no mention is made of operative verification, and one from the Mayo Clinic, with desirable details lacking. If we accept the cases in Horn's paper, we have a report of 8 cases.

Kehr reports two cases of situs transversus (vol. i, pp. 121 and 122), and in the absence of definite information, assuming that one of the two cases has been mentioned by Horn, we have another case. Kehr further mentions the report of Benda (vol. i, p. 123), who has found two cases of situs transversus in 10,000 autopsies at the Urban Hospital in Berlin. This gives a total of 11 cases of situs transversus.

*Floating Gall-bladder.*—A gall-bladder with a distinct mesentery and usually attended with a wide range of mobility.

CASE I.—Gall-bladder found to be small and containing numerous calculi. The remains of pericholecystic inflammation were evident in numerous adhesions.

The gall-bladder was freely movable after the adhesions were liberated and had a distinct mesovesicæ which extended from near the fundus to the cystic duct. (Deaver and Ashhurst: vol. ii, p. 43.)

CASE II.—Kehr (vol. i, p. 182) reports one case of a gall-bladder with a well-developed mesentery.

CASE III.—Author's case of floating gall-bladder. Mrs. H., aged about forty-five years, living near Ellettsville, Ind., was seen through the kindness of Dr. W. W. Harris, of Ellettsville, Ind., in consultation with Dr. Allen Pierson, of Spencer, Ind., in the month of June, 1906. She had been suffering from digestive disturbances, with vague pains in the upper abdomen. On inspection and palpation, a movable mass, somewhat the shape and about the size of a normal kidney, could easily be mapped out through a rather thin abdominal wall. The range of motion was extensive enough to permit this mass to be pushed to either kidney region, but its downward excursion was more limited. The diagnosis lay between a floating kidney and intestinal neoplasm, and a distended gall-bladder. On opening the abdomen it proved to be the latter. The gall-bladder possessed a mesentery passing between the upper surface of the same and the under surface of the liver. The operation, which occurred in a farm house, was made through the smallest possible incision, that unfortunately did not permit a careful examination of the peritoneal arrangement. The gall-bladder was aspirated, removing about 250 c.c. of clear, glycerin-like fluid, and a stone that was impacted in the neck.

CASES IV, V, VI, VII and VIII.—Brewer, in the examination of 100 subjects in the Anatomical Laboratory of Columbia University, found 5 cases of gall-bladders with distinct mesenteries, allowing considerable movement. In 3 of these there was also an extension outward of the free border of the lesser omentum to the fundus and, in one instance, to a point one inch beyond the fundus, thus forming a double mesentery, the upper being attached to the under surface of the liver, the lower to the duodenum and transverse colon, and in the one instance, to the hepatic flexure of the colon. (Brewer: *Anatomy of Gall-bladder and Ducts*, ANNALS OF SURGERY, vol. xxix, p. 723.)

*Absence of Gall-bladder.*—Including only cases of a congenital absence or agenesis, as opposed to an absence of gall-bladder due to a destruction of the same through a pathologic process.

CASE I.—The case occurred in a rachitic colored child, two years old, that had never walked unsupported and had presented no symptoms suggestive of any anatomic peculiarity referable to the biliary apparatus or to other structures.

At the postmortem the liver appeared of normal size and condition. It presented a whitish nodule at its anterior margin.

Histological examination of section from which shows the remains of hepatic parenchyma in part in a state of fatty degeneration, together with the hyperplasia of connective tissues, accumulations of round-cells, and in places homogeneous

## ANOMALIES OF THE GALL-BLADDER AND BILE-PASSAGES

loss of structure, changes that I take to be syphilitic origin. The section that I exhibit shows the presence of the hepatic portal and biliary vessels. No gall-bladder could, however, be found, either attached to or detached from the liver, or even contained within the structure of this organ, and as I show you, the usual fissure for the gall-bladder is wanting, and there is nothing suggestive of the previous presence of this viscus.

The case thus clearly resolves itself into one of agenesis of the gall-bladder. The absence of the gall-bladder is common in some animals, as, for instance, the elephant, the rhinoceros, the camel, the goat, the deer, and some species of fish, some birds, and some rodents.

CASE II.—In 1865, Sands (*New York Medical Journal*, June, 1865, vol. i, p. 222), before the New York Pathological Society, reported finding in the dissecting room in a tuberculous male subject, about twenty years old, a liver without a gall-bladder and without a fissure for its lodgement. The liver was small, weighing one and three-fourths pounds, and its quadrate lobe was wanting.

CASE III.—Tambault and Schachman (*Bulletin de la Société Anatom. de Paris*, 1882, lvii, Ann. 4e sér., tome vii, p. 499) have reported the case of a parietic dement, who after death presented, in addition to classic lesion of parietic dementia, a small liver with absence of the gall-bladder; the fossa for this viscus being replaced by a small fissure. There was no indication of a cystic duct. The hepatic ducts presented no abnormalities. During life there had been no symptoms suggestive of the absence of the gall-bladder. (A. A. Eschner: Congenital Absence of the Gall-bladder, *Med. News, Phil.*, 1894, lxiv.)

The same author reported a series of 12 cases, including his own, and from these 12 cases the first 3 above reported have been taken, the remaining 9 of Eschner's list being too doubtful to justify repetition. Eschner himself is uncertain regarding the majority of his cases as being cases of agenesis of the gall-bladder.

CASE IV.—This specimen was removed at the post-mortem examination of a man, aged forty-nine, who died from pulmonary tuberculosis. There was nothing of any interest in his previous history. The main point of interest about the specimen is that, in spite of the absence of the gall-bladder, the hepatic ducts are normal, and there is no dilation of the bile ducts. (Arthur Latham: Absence of Gall-bladder. *Journal of Anatomy and Physiology*, 1897-1898.)

CASE V.—According to Rolliston, a second one was shown by Thursfield, at a meeting of the Pathological Society in 1903. Both of these (one of these being Latham's) were carefully dissected, so there was no doubt that the condition was one of complete absence and not extreme fibrosis after inflammation.

CASE VI.—There is a third specimen in the London Hospital Museum, No. 1395 A, where also the condition is clear. In this case there is a deep furrow in the position which the gall-bladder should occupy, so that the quadrate lobe is quite distinct from the rest of the right lobe. (A. J. Walton: *Lancet*, 1912, p. 925.)

CASE VII.—The case was that of a child that died on the eighth day. The abnormally large right lobe over the left was apparent from the upper surface. On the under surface the absence of the gall-bladder and the lobus quadratus, as well as the unusually small left lobe, were notable. The sagittal fissure was converted into a canal through the presence of a bridge of liver substance. This canal was traversed by the umbilical veins. (Hochstetter, F., *Archiv f. Anatomie u. Physiologie*, 1886.)



Förster refers to the gall-bladder being absent in a number of cases and adds that in such cases the common duct is usually larger than customary. He also mentions the possible absence of the common and hepatic ducts, and in other cases the hepatic ducts remaining united and emptying separately into the duodenum, or one into the duodenum and the other into the stomach, and, further, the possible division of the common duct in which one-half communicates with the stomach and the other half with the large intestine. (Förster, August: *Die Missbildungen des Menschen*, Jena, 1865).

Weltz, without giving details, refers to cases of absence of gall-bladder reported by Wahlborn, A. G. Richter, Wiedeman, Amussat, and Buttner. (Weltz, G. H.: *Ueber Divertikel der Gallenblase*, Kiel, 1894.)

*Hour-glass Gall-bladder*.—A gall-bladder consisting of two cavities separated by a pervious isthmus. Adhering to the rule of recognizing only such anomalies that are of congenital origin, instead of anomalies dependent upon a pathologic process, the writer has been unable to find any instance of a true hour-glass gall-bladder. Several cases of hour-glass gall-bladder of an inflammatory origin have been recorded by Deaver and Ashhurst and Kehr, as follows:

Adhesions between the gall-bladder and stomach. These were ligated and cut and the gall-bladder was found to be hour-glass in shape, both pouches filled with calculi. The other reference by Deaver is as follows: Adhesions between liver and duodenum. Gall-bladder was hour-glass in shape, the two portions being united by a fibrous band. Distal portion, which was free from calculi, was removed. Proximal portion contained four stones. Cholecystostomy was performed. (Deaver: vol. i, p. 43.)

Kehr refers to several cases of hour-glass gall-bladder due to the presence of a former ulcer.

#### ANOMALIES OF BILE PASSAGES

*Double Cystic Duct*.—CASE I.—Dr. Dressmann reports a case of double cystic duct as follows:

The woman was forty-two years of age. For the last six or seven years she had abdominal pains, especially at the time of her menstruation. On examination a tumor the size of a fist, movable and occupying the left side above the level of the umbilicus. The uterus was anteflexed and had a small subserous myoma. An abdominal section was performed January 4, 1907. The left-sided movable tumor above referred to proved to be an enlarged and elongated gall-bladder containing numerous large stones. A cholecystectomy was performed. The bladder was separated from the liver, cystic artery ligated, and the cystic duct divided to permit an investigation of the common duct. After a division of the cystic duct, much to the surprise of the operator, a second cystic duct became apparent. On careful investigation it was proven that both ducts united just before their junction

## ANOMALIES OF THE GALL-BLADDER AND BILE-PASSAGES

with the common duct. These two ducts paralleled one another and opened independently in the gall-bladder, each opening being separated from the other through a space of 1 cm. (Dressmann: *Deutsche Zeitschrift für Chirurgie*, vol. xcii, 1908, p. 401.)

CASE II.—Kehr refers to two cases of double cystic duct reported by Ruge and Dressmann, the latter being the foregoing case (vol. i, p. 127).

*Anomaly of Hepatic Duct.*—CASE III.—The specimen was taken from the body of a man, aged forty-nine, who died in the Great Northern Hospital, under the care of Dr. Cholmeley.

The excretory apparatus of the liver is here so arranged that the whole of the bile must have passed through the gall-bladder on its way to the intestine. The gall-bladder itself is much smaller than usual. When laid open it measured two inches in length, and rather less in breadth. It would hold about two drachms of fluid. In its upper or attached wall, there are two openings, the larger one near the centre is the orifice of the principal hepatic duct, the smaller one nearer the fundus is the orifice of a cystohepatic duct. The large ducts of the left lobe pass across the longitudinal and transverse fissures where they become superficial, and join the principal duct of the right lobe shortly before it opens into the gall-bladder.

The cystic duct which appears to be the sole channel of communication between the liver and duodenum is, at its commencement, constricted so as to admit nothing larger than a probe, but immediately dilates considerably. The arrangement described in this case, which appears to be so abnormal in man, is the normal one among some of the lower animals. Thus Prof. Owens states that in certain fishes, wolf fish, *Erythrum Lepidosiren*, the bile is conveyed to the gall-bladder by hepatocystic ducts, and thence by cystic duct to the duodenum. Again in certain reptiles *Siren Amphiuma* the hepatic ducts communicate with the cystic or the gall-bladder, and the bile is conveyed directly by the cystic duct to the beginning of the intestine. In *Mammalia*, on the other hand, as a rule, all ducts unite into one trunk, which in those having a gall-bladder joins the cystic duct to form the common duct.

*Malformation of the Gall-bladder and Hepatic Duct.*—H. H. Crooknell (Trans. Path. Soc. London, vol. xxii, p. 163.)

CASE IV.—See Case I, Double Gall-bladder. The hepatic duct divided into three divisions, right, left and posterior. These ducts did not communicate with one another, but remained distinct throughout their course.

*Accessory Hepatic Ducts.*—CASES V, VI and VII are represented by three cases reported by Kehr, which terminated blindly near the neck of the gall-bladder. Kehr further describes three possible anomalies of the hepatic duct and gall-bladder, one consisting of accessory hepatic duct, emptying directly into the gall-bladder, as it occurred in one of his cases. Second, where the right hepatic duct, singly or divided, empties into the gall-bladder, so that the bile from the right lobe passes through the gall-bladder in its way to the common duct, or duodenum, and a third variety, in which both hepatic ducts emptied directly into the gall-bladder and thus all the bile passed through the gall-bladder on its way to the duodenum (vol. i, p. 127).

*Absence of Common Duct.*—CASE VIII.—After an easy and natural labor of some four hours' duration, she was delivered of a well-developed boy weighing

a little over 9 pounds. For the twenty-four hours after birth, the child betrayed no abnormal symptoms. At my next visit, however (about thirty hours after delivery), I noticed an icteric appearance of the countenance, and upon closer inspection a well-marked yellow tinge on the whole surface was discovered. The nurse informed me that the discharges from the bowels were "almost like clay" and that the child had frequent attacks of vomiting. The symptoms continued to grow worse. The color of the skin changed to a brownish-yellow or bronze. The irritability of the stomach increased, convulsions supervened and in about twelve hours after my second visit, or seventy-two hours after birth, the child died in profound coma.

Sectio cadaveris, the tissues throughout the body were stained intensely yellow. The liver was swollen and enlarged. This was evidently due to distention of the biliary duct, as upon cutting into it an unusual amount of very thick bile oozed from the cut surface. The gall-bladder occupied its normal position and was enormously distended with bile of about the consistency of syrup. The cystic and hepatic ducts presented nothing unusual except that they were very much enlarged, a point I shall allude to again. They united at the usual place to form the common duct, the ductus communis choledochus also was very greatly distended and was about  $\frac{3}{4}$  inch long; it then terminated abruptly in a very blunt, club-shaped extremity, without reaching the intestinal wall at all. (I. N. Danforth: Chicago Med. Jour., vol. xxvii, p. 110, 1870.)

GESSNER (Ueber Congenitalenverschluss der Grossen Gallengange, Halle, 1886), after collecting the reports of 24 cases of congenital obliteration of the major bile passages, to which a twenty-fifth case, his own, was added, reached the following conclusions:

1. That so far no undoubted case of congenital obliteration of the major bile passages has been observed.
2. That many so-called cases are of uncertain etiological origin.
3. That the most certain, if not satisfactory, explanation for the so-called malformations, is a condition that is luetic in origin.

AUTHOR'S COMMENT.—None of Gessner's cases, in the writer's opinion, justified acceptance. All were in infants of a few weeks to a few months of age. A number were outspoken luetic, others doubtful, and still others more remotely doubtful. The cases suggested a luetic perihepatitis that has its origin during the fetal period of existence and resulted in an atresia rather than a malformation. In fact some of Gessner's cases were entirely free from jaundice at birth.

#### CONCLUSIONS

1. Refinements in operative and diagnostic technic demand a detailed knowledge of the anomalies of abdominal organs, and therefore it behooves us to more fully investigate and report the various anomalies as they present themselves.
2. A more thorough search should, if possible, be made at the time

## ANOMALIES OF THE GALL-BLADDER AND BILE-PASSAGES

of operation, and the operative procedure, carried out through an incision yielding a more accurate survey of the field of activity.

3. The "button-hole incision" is not alone responsible for incomplete surgery, but through its employment many anomalies are overlooked.

4. Anomalies of the hepatic region follow the rule of anomalies in other regions in not occurring singly, *i.e.*, an anomaly of the gall-bladder may have an attending anomaly of the ducts or the blood supply or some other part of the hepatic system.

5. A double gall-bladder is one in which each gall-bladder has its independent cystic duct, thus differentiating it from a bifid gall-bladder in which the cavities are distinctly separate, but communicate with the common duct through a single cystic duct.

6. Five cases of double gall-bladder are recorded. Of these, one case was without other anomalies. Of those in which other anomalies were present (Case I) there existed, in addition to the double gall-bladder, an anomaly of the hepatic duct, which, instead of dividing into two branches, divided into three, right, left and posterior, and these ducts did not communicate with one another, but were distinct in their whole course. Case II, one gall-bladder was located on the right lobe and the other on the left lobe. Case III, there occurred a subdivision of one of the cystic ducts. Case V, there existed a mesentery, one blade of which became lost over the duodenum and the other over the hepatic flexure of colon.

7. In a bilobed gall-bladder the cavity consists of two lobes with a single cystic duct. Of this anomaly there is one recorded case.

8. In a diverticulum of the gall-bladder there is one large cavity and a smaller recess communicating with the larger or true gall-bladder cavity.

9. Seven cases of diverticulum of gall-bladder are recorded. Of these, 5 cases were simple and 2 cases complicated. Case II was complicated by a division of the common duct just beyond the entrance of the cystic duct; Case III by unusual vascular anomalies.

10. An intrahepatic gall-bladder is partly or entirely imbedded in the liver substance instead of merely occupying the classical gall-bladder depression. Of this anomaly 16 uncomplicated cases are recorded.

11. A completely imbedded gall-bladder may be confused with a left-sided or absent gall-bladder. According to Dévé, this anomaly is most common in infants and reptiles.

12. A left-sided gall-bladder occupies a position to the left of the falciform ligament in a normally placed liver. Of this anomaly 13 cases

are recorded. Seven cases were uncomplicated. Case II was complicated by an abnormal arrangement of the caudate and quadrate lobe, Case IV by an ectopia of gall-bladder. Cases VII and VIII by vascular and lobar anomalies. Case IX by absence of quadrate lobe. In Case XIII two gall-bladders existed, one on the right and the other the left lobe.

13. A left-sided gall-bladder may be concealed behind the falciform ligament and at an operation be overlooked entirely, or confused with a congenital absence, extreme fibrosis, or an intrahepatic gall-bladder.

14. In transposition of viscera, the liver not only occupies the left instead of the right hypochondrium, but there is a reversal of the lobe, the left being larger than the right and receiving the gall-bladder. There is a dextroposition of the heart, as well as reversal of the duodenum and stomach, which becomes our most important diagnostic aid. Of this anomaly, 11 cases are recorded.

15. A floating gall-bladder has a distinct mesentery and is usually attended with a wide range of mobility. Of this anomaly there are eight cases recorded.

16. Absence of gall-bladder includes only cases of agenesis or congenital absence, as opposed to absence due to destruction through pathologic process. There are 7 cases of this anomaly recorded. Of these, Cases II and VII were complicated by the absence of quadrate lobe.

17. Absence of gall-bladder is common in some animals, elephant, rhinoceros, camel, goat, deer, some species of fish, some birds, and some rodents (Eschner).

18. There were no cases of congenital hour-glass gall-bladder discovered. Several cases are on record occasioned by pathologic processes.

19. There were eight cases of anomaly of bile passages as follows: 2 cases of double cystic duct; 5 cases of anomalies of hepatic ducts, and 1 case of absence of common duct.

20. The total anomalies numbered 76, of which 62, or 81+ per cent., were single, and 14, or 18+ per cent., were multiple.

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# ANOMALIES OF THE GALL-BLADDER AND BILE-PASSAGES

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# THE INTERPRETATION OF FUNCTIONAL RENAL TESTS WITH SPECIAL REFERENCE TO THE SIGNIFICANCE OF MINIMAL EXCRETION OF PHTHALEIN AND INDIGO- CARMIN \*

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THE last word in functional renal tests is still far off. In the meanwhile conscientious study will clear the way to that goal. The practical value of these tests becomes more and more evident as one succeeds in improving the interpretation of the facts elicited. In research along these lines one encounters many puzzling contradictions and it will take much more work to explain many of them. Why a given kidney (*e.g.*, a case of ureter stone) secretes more urea than its mate, but fails to excrete indigo-carmin while its mate does it normally, or why a patient dies of uræmia while the pht halein output is normal or almost normal illustrate some of the perplexities that one encounters. As the above are exceptional occurrences the important practical point in all this work, it seems to me, is *to arrive at an understanding of the significance of zero or minimal excretions*, so that we may be guided intelligently and thus get the best possible operative results. This viewpoint has not received the attention it deserves. In the discussion of the paper of J. T. Geraghty before the Genito-Urinary Section of the American Medical Association in 1912, I suggested the appointment of a central committee which would gather cases and investigate the significance of all negative (zero or minimal excretion, etc.) test results. As nothing was done along these lines I have continued to give this point my particular attention during recent years and have had the opportunity of studying a number of such cases. Unless one has a very large material it is difficult to gather a convincing array of evidence along these lines. I feel that my series of cases should be recorded in the hope that they will stimulate others to

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\* Read before the N. Y. Surgical Society, April 12, 1916. This article is practically an experimental laboratory study, based on carefully studied clinical material. The observations will be fully but briefly stated so that the reader may check up the validity of the deductions.

gather facts along the same lines and thus aid in establishing firmly the significance of zero or minimal excretions.

Fortunately positive results, *i.e.*, good excretion of test substances, usually mean good function. Occasionally hyperfunction, however, may accompany severe disease and be very misleading. In 1908<sup>1</sup> in a paper referring to the influence exerted by a diseased kidney on the excretory work of the second organ, I called attention to this difficulty. Since then Baetger has emphasized this in his presentation of cases of hyperpermeability, and Ellis Foster in his series of cases dying of uræmia with high phthalein output. This phase of the question will not be discussed any further in this paper. It will be evident from a perusal of the following cases that every case in which the output of phthalein or of indigo-carmin is minimal must be carefully analyzed, as in this group of cases careless study and false deductions will lead to unwise operative measures which will be followed by a very, and, unnecessarily, high mortality.

In the following pages the cases will fall into natural groups:

(a) In the first group will be described a series of cases in which there was minimal excretion of test substances, etc., due to symmetrical<sup>2</sup> renal disease usually caused by obstruction, *e.g.*, adenoma of the prostate, stricture of the urethra, interstitial cystitis, etc., and in which preliminary treatment failed to improve renal output and a fatal ending ensued (or threatens), due to renal insufficiency (Cases I to VI).

(b) In the second group similar cases in which preliminary therapy succeeded in restoring function and in which operation could be successfully performed (Cases VII and VIII).

(c) In the third group cases in which the lowered output was due to inhibition toxic or reflex, and on the basis of this interpretation, operation (successful) was permissible (Cases IX to XII).

(d) In the fourth group cases of more or less a symmetrical renal involvement in which the kidney or kidneys had to be directly attacked before any improvement in renal function was to be expected. Success in this group of minimal excretion cases depended, I believe, on rapidity of operation, substitution of gas and oxygen anæsthesia (or spinal or local) for ether and adequate drainage so as to avoid wound infection (Cases XIII to XVII).

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<sup>1</sup> Beer, E.: The Phloridzin Test with Special Reference to the Influence Exerted by a Diseased Kidney on the Excretory Work of the Second Organ. Jour. Am. Med. Assn., 1908, 1, 1975.

<sup>2</sup> Palpation, X-ray cystoscopy, etc. (autopsy).



## GROUP A

CASE I.<sup>3</sup>—H. S., aged sixty years, admitted February 12, 1912. Died May 26, 1912.

*Diagnosis: Prostatic adenoma, cystitis, vesical calculi, bilateral hydro-ureter and hydronephroses, uræmia.*

For past year has had attacks of frequency and of burning on urination. Three weeks ago a number of vesical calculi were evacuated through the sheath of the cystoscope. Of late, frequency is very great, every hour or half hour, and has pain over bladder.

The patient's general condition appears good and does not suggest a renal insufficiency. He is well nourished. There is moderate arteriosclerosis and moderate increase in tension.

X-ray of genito-urinary tract is negative. Palpation of the kidneys is negative.

February 13, 1912: Cystoscopy shows a diffuse cystitis and numerous small calculi (uratic). The prostate is enlarged. Many stones washed out of bladder through sheath of cystoscope. Regular catheterizations and bladder washings employed.

February 14, 1912: *Phthalein test* (No. 1). No excretion, urine collected for four hours twenty minutes. Urine contains pus and albumin.

February 15, 1912: *Phthalein test* (No. 2). No excretion. Urine collected for two hours twenty-five minutes.

February 16, 1912: *Phthalein test* (No. 3). Faint trace excreted after one hour.

February 16, 1912: *Phloridzin test* (minims 15 of 1 per cent. solution). No sugar excreted in fifty-three minutes.

*Indigo-carmin test* (No. 1) (drachms 3 of 0.4 per cent. solution). No coloring matter in urine until three hours fifty minutes, when faintest color appeared.

*Urea output* was 1 per cent. = 18.6 grammes in twenty-four hours.

In spite of attempts to relieve his kidney insufficiency, nothing was accomplished and patient, refusing further treatment, went home. He was readmitted May 10, 1912. He had felt fairly comfortable for one month after discharge, but during the last two months he had become worse again and had become incontinent. Now a permanent catheter was introduced. His eye grounds were negative. Urine contained pus and albumin.

May 13, 1912: *Indigo-carmin test* (No. 2). After three hours forty minutes, a faint excretion appeared.

*Urea output*: 1.1 per cent. or 17.6 grammes.

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<sup>3</sup> Histories are abbreviated.

## FUNCTIONAL RENAL TESTS

May 16, 1912: *Phthalein test* (No. 5). After five hours there was the faintest excretion.

May 16, 1912: About 100 small stones removed from the bladder through the sheath of the cystoscope. With lithotrite some larger stones crushed and evacuated (novocaine local anæsthesia). Operation was brief and three separate instruments were introduced into the bladder, each only once, cystoscope, lithotrite and again cystoscope. There was no injury and patient was not excited.

May 17, 1912: Patient is dull and quiet; distinctly uræmic. Tongue is dry; vomited several times.

May 20, 1912: Under active treatment patient improved and came out of his acute uræmic state.

*Phthalein test* (No. 6). After two hours fifteen minutes, faintest reaction. During the next 24 hours inestimable amount of phthalein was excreted.

May 22, 1912: *Urea output*: 1.2 per cent. or 11 grammes.

Without local anæsthesia many more stones rapidly evacuated without any injury and without any distress to the patient.

May 23, 1912: *Urea output*: 1.5 per cent. or 19 grammes.

May 25, 1912: Patient has again become duller, breathing labored, pulse weaker; passes less urine; placed on same treatment as before without avail.

May 26, 1912: Became more and more stuporous; breath urinous, and died in uræmia.

*Autopsy*.—Prostatic adenoma with hypertrophied bladder; marked cystitis and a few vesical calculi; hydro-ureter and hydronephroses on both sides, and atrophic contracted kidneys.

*Summary*.—In this case the prostatic adenoma had gradually led to a symmetrical supravescical renal destruction which showed itself by continued failure to excrete phthalein (six tests), indigo-carmin (two tests) and phloridzin glucose (one test). Despite removal of the stones and despite removal of the obstruction by employing an indwelling catheter, it became evident that the kidneys were permanently disabled and, even though the urea output was good, an operative attack on the prostate was absolutely contra-indicated.

CASE II.—D. G., aged sixty-six years, admitted October 29, 1913. Died November 13, 1913.

*Diagnosis*: Prostatic adenoma, chronic cystitis, hydro-ureter and hydronephroses on both sides, uræmia.

Until four years ago, well, when he was taken ill with gastric symptoms, pyrosis, eructations, vomiting; he became costive. There was neither headache nor visual disturbances. Marked in-

creased frequency developed and of late retention, which required catheterization. Since four weeks in bed because of weakness.

*Examination.*—General condition fair, emaciated, tongue dry. Heart sounds of fair force. Second aortic accentuated. Some general arteriosclerosis. At right apex signs of tuberculous process. Prostate was enlarged per rectum. There was slight œdema about ankles. Blood-pressure was 130 millimetres. Residual urine 9 ounces. X-ray examination is negative. Palpation of kidneys is negative.

*Therapy.*—Permanent catheter introduced and measures to combat the disturbance in kidney function instituted.

October 30, 1913: *Phthalein test* (No. 1). Negative; no excretion in twenty-four hours.

October 31, 1913: *Indigo-carmin test* (No. 1). Negative; no excretion. Urine drained in good amounts, contained slight trace of albumin and some pus-cells; urea 1.6 per cent.; in twenty-four hours 16.3 grammes.

November 1, 1913: *Phloridzin test* (No. 1). Negative; no sugar excretion in twelve hours.

November 3, 1913: Fundus examination shows slight changes commonly seen in chronic nephritis.

*Phthalein test* (No. 2). After three and one-quarter hours very faint reaction.

November 4, 1913: *Indigo-carmin test* (No. 2). No excretion in twenty-four hours.

November 5, 1913: *Phloridzin test* (No. 2). Very faintest glucose reaction at four hours.

*Albarran polyuria test* repeatedly negative.

November 11, 1913: *Phthalein test* (No. 3). Faintest excretion in four hours.

November 13, 1913: Despite attempts to restore the kidney function, the patient gradually became more uræmic, and died.

*Autopsy.*—Prostatic adenoma, chronic cystitis, hydro-ureter and hydronephroses, with extensive parenchymatous and interstitial nephritis.

*Summary.*—In this case, as in the previous one, the obstructive adenoma had led to a permanent disturbance in kidney function, by producing a symmetrical destruction of secreting parenchyma. In view of the fact that no improvement followed the use of a permanent catheter and the use of anti-uræmic measures, etc., it became evident that the outlook was most unfavorable, and that surgical measures were contra-indicated.

## FUNCTIONAL RENAL TESTS

CASE III.—W. J., aged forty-seven years, admitted November 18, 1915. Died December 22, 1915.

*Diagnosis: Old urethral stricture; multiple perineal sinuses and abscesses; chronic uræmia.*

Patient has been under irregular observation for a number of years and has had attacks of pyelonephritis from time to time. He entered the hospital complaining of abscesses in perineum which have developed from the urethra following stricture. On admission his general condition was good. His appearance did not suggest that he was on the verge of a fatal uræmia. Abscesses opened under local anæsthesia. Urine contained a trace of albumin and many pus-cells. X-ray examination and palpation of the kidneys were negative.

November 26, 1915: *Phthalein test* (No. 1). First appearance of dye in one hour fifty-five minutes. In two subsequent hours only traces excreted. *Blood urea* 96.6 milligrammes; incoagulable nitrogen 181.4 milligrammes per 100 cubic centimetres.

November 30, 1915: *Phthalein test* (No. 2). Excretion time one hour fifty-five minutes. In three subsequent hours only traces excreted.

December 2, 1915: Eye grounds show slight temporal pallor, otherwise normal (Dr. J. Wolff).

December 2, 1915: Blood pressure: systolic, 128 millimetres; diastolic, 107 millimetres.

Revision of suppurating sinuses under gas and oxygen anæsthesia. Introduction of permanent catheter past the obstruction to determine whether kidneys were temporarily or permanently damaged.

December 4, 1915: *Phthalein test* (No. 3). Excretion time two hours fifteen minutes. In two subsequent hours only traces were excreted.

December 7, 1915: *Phthalein test* (No. 4). Excretion time three hours. Only traces excreted.

*Blood urea*, 88.2 milligrammes; incoagulable nitrogen, 101.5 milligrammes per 100 cubic centimetres.

December 10, 1915: *Phthalein test* (No. 5). Only traces excreted.

During these days total output of urine varied from 63 ounces to 19 ounces. The patient was becoming distinctly weaker and more apathetic. His tongue was usually dry and appetite poor.

December 10, 1915: Total urine, 1024 cubic centimetres; urea, 0.7 per cent.

December 13, 1915: *Phthalein test* (No. 6). Only traces excreted.

Blood-pressure: systolic, 98 millimetres; diastolic, 75 millimetres.

December 16, 1915: *Phthalein test* (No. 7). Excretion time two hours forty-five minutes. In two subsequent hours traces, but no estimable amount excreted.

December 18, 1915: *Alveolar air*,  $\text{CO}_2 = 5.4$  per cent.

December 20, 1915: *Phthalein test* (No. 8). Excretion time two hours thirty-five minutes. In two subsequent hours about 6 per cent.

December 22, 1915: Patient decidedly worse. Pulse feeble. Babinski on right side. Respirations shallow. Stupor has set in. Marked oliguria (4 ounces in last twenty-four hours). Death in coma.

*Summary.*—As the result of an old stricture which had been neglected, this patient developed bilateral pyelonephritis which ended in a distinct renal insufficiency. This showed itself definitely in the test of renal function and was not suspected until these tests were made, as the general appearance and physical examination did not suggest an impending uræmia. An attempt was made to restore the kidney function, first by draining the areas of suppuration from which toxic materials were being absorbed, and second by relief of the obstruction to the urinary outflow by employing an indwelling catheter. Both attempts failed to bring about any material improvement, though the retention in the blood dropped slightly and the phthalein output increased a few points. This lack of response to measures aiming at restoration of function led to the conclusion that the changes in the kidneys were of a permanent character and the fatal outcome bore out the conclusions reached.

CASE IV.—I. W.,<sup>4</sup> aged sixty-one years, admitted November 2, 1914. Died November 23, 1914.

*Diagnosis:* *Carcinoma of prostate, chronic nephritis, uræmia.*

Three years ago acute retention. Since then frequency, some dysuria. Three weeks ago hypogastric pain, loss of appetite, nausea, vomiting. Lost eighteen pounds during past eight months.

As patient has almost absolute retention a permanent catheter was introduced and subsequently suprapubic puncture made. His general condition was fair and did not suggest uræmia. X-ray examination and palpation of the kidneys were negative.

His urine contained blood-cells (traumatic), a trace of albumin, and some finely granular casts. He passed as much as 1500 cubic centimetres containing 1 per cent. urea or 15 grammes in 24 hours.

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<sup>4</sup>Through the courtesy of Dr. C. A. Elsberg, this case was studied by the writer.

## FUNCTIONAL RENAL TESTS

November 3, 1914: *Phthalein test* (No. 1). First appearance in one hour. In subsequent two hours, 4.5 per cent.

November 5, 1914: *Phthalein test* (No. 2). No excretion in twelve hours.

November 7, 1914: Fundus examination: optic discs have a slightly blurred and woolly outline, which may indicate the beginning of a low grade neuritis (Dr. J. Wolff).

November 8, 1914: 66 ounces of urine secreted; urea, 1.2 per cent.

November 10, 1914: *Indigo-carmin test*: No excretion.

November 13, 1914: Blood-pressure, 135 millimetres.

November 14, 1914: *Phthalein test* (No. 3). In three hours 5 per cent. excreted.

November 16, 1914: *Phloridzin test* (No. 1). Gr. 1/10 injected. No glycosuria in next twenty-four hours. *Blood urea*, 88 milligrammes; incoagulable nitrogen, 100 milligrammes per 100 cubic centimetres.<sup>5</sup>

November 18, 1914: *Phloridzin test* (No. 2). Gr. 1/6 injected. No glycosuria in next twenty-four hours.

November 23, 1914: Patient gradually became comatose and died in uræmia.

*Summary.*—In this patient, as in the previous three, it was impossible to repair the damage done to the two kidneys by the longstanding obstruction to the outflow of urine. Even though this back pressure was relieved by permanent catheter, all the tests remained practically negative and it soon became evident that a fatal uræmia would develop.

CASE V.—M. G., aged forty-eight years, admitted May 7, 1915. Died February 21, 1916.

*Diagnosis:* *Chronic interstitial (contracted bladder) cystitis, bilateral nephritis, uræmia.*

Patient had bladder symptoms for more than twenty years. Suprapubic cystostomy fourteen years ago gave no relief. Capacity of bladder very small and frequency very great. Has lost much weight and become weak. Patient looked pale and waxy, suggesting a chronic intoxication. His urine contained a heavy trace of albumin, red-cells and pus-cells. X-ray examination and palpation of the kidneys was negative.

May 22, 1915: Fundi show low grade optic neuritis with a few small scattered hemorrhages in retina (Dr. J. Wolff).

May 25, 1915: *Phthalein test* (No. 1). No excretion of phthalein.

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<sup>5</sup> Dr. Lautman made most of the blood analyses.

May 27, 1915: Blood-pressure: systolic, 180 milligrammes; diastolic, 90 milligrammes.

Permanent catheter too painful. Cystostomy to relieve back pressure refused by patient.

May 28, 1915: *Indigo-carmin test* (No. 1). No excretion.

May 31, 1915: *Phthalein test* (No. 2). No excretion.

Patient left the hospital on June 3, 1915, in practically the same condition and suffering from chronic uræmia.

September 13, 1915: Readmitted. During past two months his condition has become worse. He has lost twenty pounds and has more pain and greater frequency.

September 14, 1915: *Phthalein test* (No. 3). Traces of phthalein excreted in four hours.

September 15, 1915: Blood urea nitrogen, 77 milligrammes; incoagulable nitrogen, 120 milligrammes per 100 cubic centimetres.

September 17, 1915: Discharged and returned to hospital ten days later, feeling just as he did on last admission, but complaining, in addition, of dyspnoea and œdema about ankles. To relieve back pressure from the irritable, contracted bladder, catheters had proven unavailing and now it was decided to perform a cystostomy.

October 2, 1915: Suprapubic cystostomy under local anæsthesia.

Optic neuritis more marked than on May 22, 1915 (Dr. J. Wolff).

October 5, 1915: Large amounts, up to 108 ounces, drained. Urea concentration varies from 1.1 per cent. to 0.2 per cent.; specific gravity, 1011 to 1005; macroscopic pus; traces of albumin.

October 7, 1915: *Phthalein test* (No. 4). Traces of phthalein excreted.

October 10, 1915: *Indigo-carmin test* (No. 2). In one hour twenty-five minutes, faint traces appeared. (Previously none appeared; *v. supra.*)

October 12, 1915: Blood urea nitrogen, 74.2 milligrammes, and incoagulable nitrogen, 93 milligrammes per 100 cubic centimetres.

*Phthalein test* (No. 5). Only traces excreted in four hours.

October 16, 1915: *Phthalein test* (No. 6). Only traces excreted in three and one-half hours.

November 3, 1915: *Indigo-carmin test* (No. 3). Faint traces present in one hour ten minutes.

October 20, 1915: *Phthalein test* (No. 7). Only traces excreted.

October 26, 1915: *Phthalein test* (No. 8.) Only traces excreted.

November 1, 1915: *Phthalein test* (No. 9). Only traces excreted.

## FUNCTIONAL RENAL TESTS

November 5, 1915: Blood-pressure: systolic, 235 milligrammes; diastolic, 110 milligrammes.

Despite relief of back pressure by cystostomy it had become evident from the almost complete lack of response of the kidneys, that the renal damage was permanent, and as the drainage caused discomfort the wound was allowed to close, which it did slowly.

November 6, 1915, to December 14, 1915: *Phthalein tests* (Nos. 10 to 18) were made and always only faintest traces of the dye were excreted.

December 14, 1915: The patient was discharged in miserable condition and kept under observation in his home. His dyspnoea became more marked and a general anasarca set in, so that patient was readmitted on January 30, 1916, in worse condition than he had been when last in the hospital.

February 21, 1916: Died in uræmic coma.

*Summary.*—Here again the minimal excretion due to symmetrical supravescical disease pointed to a fatal ending. The case is particularly interesting because of the long period the patient lived with practically zero excretion. To what extent the relief of back pressure by the cystostomy helped to prolong life it is difficult to say.

CASE VI.—S. E., aged twenty years, admitted December 27, 1915.

*Diagnosis:* *Bilateral infected hydro-ureter and hydro-nephroses; nephritis; uræmia.*

Since four years has pyuria. Since seven weeks headaches, nausea, vomiting and epistaxis. Has pains in bladder and right lumbar region. The patient's appearance does not suggest renal insufficiency. He is, however, markedly pale. Urine contains a good trace of albumin, pus-cells and granular casts.

December 28, 1915: Blood urea nitrogen 131 milligrammes; incoagulable nitrogen, 200 milligrammes per 100 cubic centimetres.

*Phthalein test* (No. 1). Only traces excreted in three hours forty-eight minutes.

December 30, 1915: Cystoscopy shows a non-trabeculated, pale bladder with practically no residual urine. Both ureter meati are dilated. Faint indigo-carmin excretion from left kidney in one hour. Specimen from left kidney—urea, 0.8 per cent.; occasional cells and hyaline casts.

December 31, 1915: Blood-pressure: systolic, 148 milligrammes; diastolic, 85 milligrammes.

January 4, 1915: *Phthalein test* (No. 2). Only traces excreted.

January 12, 1916: *Indigo-carmin test* (No. 2). Faintest trace of indigo excreted. Catheter (No. 12 F.) passed into right pelvis



37 centimetres and watery secretion collected. This specimen contained urea, 0.5 per cent., and a few hyaline and granular casts. Interesting to relate despite this very evident renal insufficiency the patient successfully withstood a rather sharp infection of his antrum as well as of both middle ears.

*Summary.*—In this unusual case of non-obstructive symmetrical renal disease, therapeutically nothing could be done to relieve the condition, as it was not due to excessive back pressure. How long this patient will live cannot be predicted, as the process of destruction of the remnant of parenchyma may be accelerated or delayed. The marked blood retention, together with the minimal output of test substances, point, however, to a fatal ending in the near future.

## GROUP B

CASE VII.—M. A., aged sixty-four years, admitted November 24, 1915. Discharged January 12, 1916.

*Diagnosis: Contracture (spinal?) of neck of bladder.*

Difficulty in urination for twenty-seven years. Occasionally attacks of painful urination. During past three months urine is cloudy, and œdema of face and of legs has developed. There are anorexia and headaches. The bladder remains full after voiding small amounts. Residual urine is 1000 cubic centimetres. Rectally, prostate is small. Patient at first regularly catheterized and then permanent catheter used.

November 25, 1915: *Phthalein test* (No. 1). In three hours 4 + per cent. excreted.

November 26, 1915: Blood urea nitrogen, 37 mgms.; incoagulable nitrogen, 56 mgms.; creatinin, 1.5 mgms.; uric acid, 5.6 mgms. per 100 cubic centimetres (Dr. Bernhard).

November 27, 1915: X-ray of the genito-urinary tract was negative. Palpation of kidneys was negative.

November 29, 1915: Cysto-urethroscopy shows trabeculated and diverticulated bladder moderately inflamed. At sphincter margin minute nodule (adenoma?) and only slight intra-urethral enlargement of prostate.

November 29, 1915: *Indigo-carmin test* (No. 1). No indigo appeared in urine within seven hours of injection.

December 1, 1915: *Phthalein test* (No. 2). Total 6 per cent. excreted. Total urine, 3900 cubic centimetres; specific gravity, 1.012; urea, 0.95 per cent. (37 grammes).

December 3, 1915: *Phthalein test* (No. 3). Total 23 per cent. excreted.

## FUNCTIONAL RENAL TESTS

December 5, 1915: *Phthalein test* (No. 4). Total 12 per cent. excreted.

December 7, 1915: *Phthalein test* (No. 5)). Total 31 per cent. excreted.

December 9, 1915: *Phthalein test* (No. 6). Total 39 per cent. excreted.

December 11, 1915: *Phthalein test* (No. 7). Total 32 per cent. excreted.

*Indigo-carmin test* (No. 2). Good excretion and in strong concentration.

Blood urea nitrogen and incoagulable nitrogen normal.

December 13, 1915: suprapubic cystostomy under local anæsthesia.

December 15, 1915: *Phthalein test* (No. 8). Total 32 per cent. excreted.

December 18, 1915: *Phthalein test* (No. 9). Total 35 per cent. excreted.

December 20, 1915: Suprapubic removal of small nodule at sphincter margin and wide stretching of the contracted neck, from which the patient made a satisfactory recovery without any signs of renal insufficiency.

*Summary.*—In this case as the result of many years obstruction at the neck of the bladder a symmetrical renal disturbance seems to have developed and this showed itself both in the minimal output of test substances, but also in the general toxic symptoms. Under regular catheterizations and under permanent catheterization, it soon became evident that the renal damage was not a permanent loss of function. There was a steady improvement in the output of both indigo-carmin and of phthalein, and *pari passu* the general condition improved. With this evidence of the recuperative power of the kidneys, operation for relief of the causative agent was successfully done without development of any symptoms of renal insufficiency.

CASE VIII.—W. B., aged seventy years, admitted January 1, 1914. Discharged January 10, 1914. Readmitted March 22, 1915. Discharged May 21, 1915. Readmitted June 22, 1915. Discharged July 20, 1915.

*Diagnosis:* *Vesical calculus; prostatic adenoma.*

January 1, 1914: Patient suffering from symptoms of prostatic adenoma and bladder stone. Residual urine ounces, 10.

January 2, 1914: *Phthalein test* (No. 1). Appearance in thirty minutes, next two hours 27 per cent.

January 6, 1914: *Phthalein test* (No. 2). Appearance in thirty-five minutes, next two hours 27 per cent.

X-ray shows stone in bladder as large as hen's egg. X-ray of kidneys and palpation were negative.

January 10, 1914: Patient refused operation and was discharged.

Readmitted March 22, 1915, in much worse condition.

For more than two years patient had been carrying a vesical calculus which had grown to a very large size. His prostate was large and his urine contained pus, red-cells, trace of albumin, specific gravity, 1026, urea, 0.5 per cent. (amount ounces, 81).

March 24, 1915: *Phthalein test* (No. 3). First appearance in two hours twenty-five minutes. Total in subsequent two hours about 5 per cent.

In view of the impossibility of relieving the kidneys by use of indwelling catheter, it was determined to remove the very large stone which acted as the obstructive factor.

Cystostomy and removal of very large calculus which was firmly held by the contracted and thickened bladder (under local anaesthesia).

March 25, 1915: *Indigo-carmin test* (No. 1). Very faint excretion in two hours thirty-five minutes. Intensity remained minimal (and did not become stronger on oxidation).

*Phloridzin test* (No. 1). Specimens collected (seventeen in all) every fifteen minutes for three and one-half hours and no glycosuria detected.

Blood pressure: systolic, 160 milligrammes; diastolic, 90 milligrammes.

March 26, 1915: *Phthalein test* (No. 4). Appearance in one hour fifty minutes. In subsequent two hours, 8 per cent.

March 29, 1915: *Phthalein test* (No. 5). Appearance in one hour fifteen minutes. In subsequent two hours, 10 per cent.

Blood urea nitrogen 46.4 milligrammes; incoagulable nitrogen, 75 milligrammes per 100 cubic centimetres.

March 30, 1915: *Indigo-carmin test* (No. 2). In one hour fifty-five minutes indigo appeared in urine in stronger concentration than at first test.

April 6, 1915: *Phthalein test* (No. 6). Appearance in one hour thirty-five minutes. Total in next two hours dropped again to 5 per cent.

April 8, 1915: *Indigo-carmin test* (No. 3). Appearance in forty-five minutes. Within two and one-half hours dark blue, strong excretion. Meanwhile patient's general condition was improving.

April 9, 1915: Blood urea nitrogen, 46.4 milligrammes; incoagulable nitrogen, 74.9 milligrammes per 100 cubic centimetres.

## FUNCTIONAL RENAL TESTS

April 13, 1915: *Phthalein test* (No. 7). Appearance in forty-five minutes; next two hours, 10 per cent.

Blood pressure: systolic, 155 milligrammes; diastolic, 100 milligrammes.

May 18, 1915: Patient has steadily improved in general health. *Phthalein test* (No. 8). Appearance in twenty-five minutes; next two hours, 45 per cent.

May 21, 1915: Patient allowed to go home with cystostomy opening and instructed to return for prostatectomy.

June 22, 1915: Readmitted and successful prostatectomy performed.

*Summary.*—This patient on his second admission demonstrated a progressive disturbance of kidney function. Whereas at his first admission he was in fairly good condition and passed plenty of the test substance, on his second admission his excretion was minimal. It was evident that as long as the giant calculus remained in his bladder, back pressure against the kidneys could not be relieved, and it was therefore determined to remove this calculus under local anæsthesia. After relieving this condition, it became evident that the kidney function was only temporarily disturbed, and as the kidneys excreted more and more indigo-carmin, and more and more phthalein at each successive test, the patient's general condition improved sufficiently to allow of a successful prostatectomy. Had the tests, however, remained unchanged, had the kidneys shown a permanent loss of function, such an operation would have been contra-indicated.

### GROUP C

CASE IX.—W. F., aged sixty-four years. Admitted March 12, 1913. Discharged July 28, 1913.

*Diagnosis: Adenoma of prostate; calculous pyonephrosis.*

For ten years patient had frequency and dysuria. He had passed gravel and blood. Examination showed an almost impassable urethral stricture, and, as patient was septic, with petechial rash, on

March 19, 1913: A suprapubic cystostomy was performed, preliminary to the proposed secondary prostatectomy.

Blood pressure: systolic, 185 milligrammes.

Fundus examination negative (Dr. J. Wolff).

Blood culture negative.

Urine: Specific gravity, 1008; urea, 1.2 per cent.; much pus; good trace of albumin.

March 31, 1913: *Phthalein test* (No. 1). Thirty-seven per

cent. in two hours. Patient's condition improved sufficiently to allow on

April 23, 1913: Prostatectomy for adenoma.

April 30, 1913: *Phthalein test* (No. 2). Thirty-five per cent. in two hours.

May 13, 1913: Of late irregular temperature up to 102.4° F.

X-ray of kidneys shows large branching calculus of right kidney.

June 13, 1913: *Phthalein test* (No. 3). Faintest trace excreted.

June 23, 1913: Cystoscopy shows pure pus coming from the right kidney. Clear urine from the left kidney which excreted indigo-carmin in eleven minutes. No indigo excreted by right kidney. Conclusion: Patient was living on left kidney.

June 25, 1913: Nephrectomy for calculous pyonephrosis. Gas and ether anaesthesia. The kidney was shrunken. Practically no parenchyma present.

July 7, 1913: Uneventful recovery.

July 16, 1913: *Phthalein test* (No. 4). In two hours 30 per cent. excreted.

July 28, 1913: Discharged well.

*Summary.*—In this case, the phthalein excretion was adequate before the third test, when, perhaps as the result of a fresh infection of the right pyonephrotic kidney, a toxic or reflex inhibition of the second kidney set in and the phthalein excretion fell to a minimal amount. In view of the fact that the patient was living on his left kidney, it was concluded that this interpretation of the low output was correct and a nephrectomy was successfully performed. After removal of the diseased kidney, the inhibition being removed, the remaining organ functionated satisfactorily and passed a good quantity of dye stuff.

CASE X.—L. K., aged nineteen years, admitted December 15, 1915.

*Diagnosis:* *Right pyonephrosis.*

Painless hematuria two years ago. Gonorrhoea four months ago; pain in right lumbar region four days ago. Of late pain radiates to testis. Chill three days ago.

Examination showed a large mass in right kidney region. No temperature.

Urine contains albumin, pus, some red-cells; urea, 0.6 per cent.; no tubercle bacilli.

December 16, 1915: *Phthalein test* (No. 1). Total output, 5 per cent.

December 17, 1915: Cystoscopy: Diffuse cystitis. Right

## FUNCTIONAL RENAL TESTS

ureter easily catheterized; left ureter opening seen but no catheter enters. No *indigo-carmin* (test No. 1) excreted in forty-five minutes. Right ureter catheter left *in situ* and bladder urine drawn to give some idea of activity of left kidney. Right kidney—Urea, 0.4 per cent.; specimen milky with pus; after two hours tinge of blue. Left kidney (bladder)—Urea, 1.5 per cent.; indigo-carmin appeared in fair concentration between one and one-half to two hours.

December 18, 1915: Alveolar  $\text{CO}_2$  = 4.3 per cent.

Blood urea nitrogen, 72.8 milligrammes; incoagulable nitrogen, 157 milligrammes per 100 cubic centimetres.

December 19, 1915: *Indigo-carmin test* (No. 2). In one and one-third hours no excretion.

December 20, 1915: *Phthalein test* (No. 2). Total output, 7 per cent.

December 22, 1915: Nephrotomy for large right pyonephrosis.

*Phthalein test* (No. 3). Total output, 15 per cent.

December 24, 1915: *Phthalein test* (No. 4). Total output, 25 per cent.

Blood urea nitrogen, 38.4 milligrammes; incoagulable nitrogen, 78.4 milligrammes per 100 cubic centimetres.

December 25, 1915: Blood pressure: systolic, 145 milligrammes; diastolic, 100 milligrammes.

December 26, 1915: *Indigo-carmin test* (No. 3). Good concentration within one hour.

January 12, 1916: *Indigo-carmin test* (No. 4). Good excretion in eight minutes.

January 15, 1916: Secondary nephrectomy for pyonephrosis. Gas and oxygen (plus one ounce of ether) anæsthesia.

January 22, 1916: *Phthalein test* (No. 5). Total output 32 per cent.

*Summary.*—In this case before drainage of the pyonephrosis, the opposite kidney functionated very poorly. This was due to either toxic or reflex influences, or both combined. As soon as the nephrotomy was performed a decided change took place, and the most striking improvement in function set in.

CASE XI.—F. F., aged thirty-eight years. Admitted December 28, 1915. Discharged January 22, 1916.

*Diagnosis: Obstructing ureteral calculus.*

Trouble began five days before admission with pain in left side and frequency of urination. Pain radiates and is paroxysmal; no fever.

December 29, 1915: *Phthalein test* (No. 1). Total output 7½ per cent.

X-ray showed a stone blocking the upper end of the left ureter.

December 31, 1915: Cystoscopy performed after pains had become less severe. Indigo-carmin excretion from the right kidney was good. From the left kidney it was delayed and in feeble concentration. Right kidney—Urea, 2.4 per cent. Left kidney—Urea, 0.8 per cent.

*Phthalein test* (No. 2). Total, 20 per cent.

January 2, 1916: Pains in left kidney region are rapidly becoming less.

*Phthalein test* (No. 3). Total output, 25 per cent.

January 3, 1916: Again paroxysmal pains in left kidney apparently due to stone becoming impacted in ureteropelvic junction. Corresponding with this, rapid fall in the phthalein output.

*Phthalein test* (No. 4). Total output, 15 per cent.

January 5, 1916: Pyeloureterotomy for calculus, followed by considerable pain.

January 7, 1916: *Phthalein test* (No. 5). Total output, 12 per cent.

January 10, 1916: *Phthalein test* (No. 6). Total output, 8 per cent.

January 11, 1916: Drainage tube withdrawn.

January 14, 1916: *Phthalein test* (No. 7). Total output, 23 per cent.

*Summary.*—In this case the accession of paroxysmal pains in the left kidney reflexly disturbed the excretory activity of the second kidney. These pains were probably due to the stone becoming impacted at the ureteropelvic junction, and, when the impaction subsided, so did the inhibition, and correspondingly the output of indigo from the right kidney as well as the combined phthalein rose to higher values. After operation until the drainage tube was withdrawn, there was again a diminution in phthalein output and subsequently again a distinct rise. The behavior of this case reminds one of a similar case reported by J. Israel, in which there was marked oliguria reflexly produced by tube pressure against the pedicle of the nephrectomized side.

CASE XII.—E. B., aged forty years. Admitted January 11, 1916. Discharged February 15, 1916.

*Diagnosis:* Calculous pyelonephritis.

Two months history of left lumbar pains. One month later another attack of pain. Two weeks ago third attack. In this attack pain radiated to left leg, and there was great frequency.

## FUNCTIONAL RENAL TESTS

Urine—Trace of albumin, many hyaline casts, some red and white blood-cells. Right kidney—Granular casts; urea, 1.7 per cent. Left kidney—Much pus; urea, 0.4 per cent.

Blood urea nitrogen, 42 milligrammes; incoagulable nitrogen, 78.3 milligrammes per 100 cubic centimetres.

January 12, 1916: *Indigo-carmin test* (No. 1). Right kidney—Slightest tinge of color in thirty-two minutes. Left kidney—No color excretion in thirty-five minutes. Subsequently color did not become more intense, always only faintest excretion.

January 13, 1916: *Phthalein test* (No. 1). Total output, 5 per cent.

January 13, 1916: Fundus examination showed moderate degree of bilateral optic neuritis.

As patient was thoroughly septic, with high temperatures, nephrotomy, decapsulation and drainage for calculous pyelonephritis. Colon b. infection in the multiple abscesses.

January 21, 1916: *Phthalein test* (No. 2). Bladder urine output only a trace; drainage from left kidney, 8 per cent.

Patient is still very sick, high temperatures due to pneumonia. Blood culture negative.

February 2, 1916: General condition much better.

*Phthalein test* (No. 3). Output in four hours, 15 per cent.

February 11, 1916: Wound almost closed. *Phthalein test* (No. 4). Output in four hours, 41 per cent.

February 15, 1916: Discharged cured.

*Summary.*—In this patient the acute septic condition of the one kidney so influenced the opposite organ as to suggest renal insufficiency. In fact the second organ had become the seat of a nephritis. The markedly toxic condition of the patient on admission was part uræmic and part septic. After relieving the acute infection of the calculous kidney a gradual improvement set in and with this the renal output approached the normal.

### GROUP D

CASE XIII.—E. R., aged thirty-eight years. Admitted March 22, 1915. Died March 25, 1915.

*Diagnosis:* *Bilateral congenital cystic kidneys; uræmia.*

Malaria years ago when he lived in the South. Nine years before admission treated for cystitis. One and one-half years ago hematuria. Cystoscopy showed blood came from left kidney. Tumor of the kidney was suspected. Hematuria has been repeated twice. During this period a large nodular mass has developed below the left costal arch. It extends well below the umbilicus and reaches into the lumbar region. It is as large as an



adult head, slightly movable and not tender. The splenic flexure and descending colon run across the large tumor. Palpation of the tumor suggested a large spleen, and, despite the history of hematuria, until the ureters were catheterized it was not proven that the growth began in the left kidney. No other masses are palpable. Urine contained a faint trace of albumin.

March 22, 1915: Cystoscopy: *Indigo-carmin* absolutely negative. Catheter passed 30 centimetres up left ureter. No secretion. Some bloody fluid obtained. The right kidney secreted pale urine; urea, 0.5 per cent. *Phthalein* test on combined urines, faint trace excreted, amount not estimable.

These examinations showed that the tumor was in all probability of renal origin and that the patient was living on his other kidney. In view of his apparent excellent health, as well as the absence of all uræmic manifestations, the negative phthalein and negative indigo tests were looked upon as due to the reflex just discussed. As the patient was in a hurry to get rid of his neoplasm (hypernephroma?) the operation was performed before the blood urea report had come in.

March 23, 1915: Lumbar incision and puncture of numerous cysts of a congenital cystic kidney, under gas and ether (ounces 3 used).

Blood urea nitrogen, 107 milligrammes; incoagulable nitrogen, 161.7 milligrammes per 100 cubic centimetres.

March 24, 1915: Occasional vomiting. Despite active therapy only 10 ounces of urine passed. Patient stupid.

March 25, 1915: Distinctly uræmic. Only 1 ounce of urine passed. Died in coma fifty-two hours after the operation.

Autopsy showed the right kidney much enlarged and polycystic.

*Summary.*—In this case there was no suggestion of uræmia before the operation. The misinterpretation of the significance of the low output of the test substances led to the operation and its fatal result. The prognostic value of high urea retention in the blood is peculiarly significant and this together with the negative color tests and operative findings made it very clear that we were facing a critical situation. Directly after the operation, the contents of the blood which had been taken as the anæsthesia was begun, were reported and most active therapy was instituted to force both kidneys to eliminate. The few ounces of ether had, however, done their work and nothing availed.

In this case, therefore, a faulty interpretation of the significance of the negative phthalein and indigo-carmin tests led to a fatal operation. The use of ether, though in small amounts, undoubtedly contributed to the issue.

## FUNCTIONAL RENAL TESTS

CASE XIV.—M. G., aged fifty-two years. Admitted June 8, 1915. Died June 14, 1915.

*Diagnosis: Bilateral calculous pyelonephritis; uræmia.*

Five years' history of colics and of hematuria. Of late, rapid loss of strength, hematuria, oliguria and vomiting. Patient sent to hospital in wretched shape and immediate X-ray examination showed large stones in each kidney. Passed one ounce of blood and urine in four hours. Pulse scarcely perceptible.

Cystoscopy showed both kidneys passed large amount of albumin and pus, but that the left secreted more urea than the right. *Indigo-carmin test* absolutely negative. It was therefore determined to nephrotomize the better kidney under spinal anæsthesia, and leave the wound wide open, so as to avoid any serious local infection. Despite the almost moribund condition of the patient the nephrotomy was done and the stone removed. Following the operation there was an immediate though only temporary improvement. Vomiting ceased, pulse became better, left kidney passed much more urine (300 cubic centimetres in first twelve hours). Gradually, however, the uræmia asserted itself again and with a blood urea nitrogen of more than 200 milligrammes to the 100 cubic centimetres, the patient became weaker and died four days after the nephrotomy.

*Summary.*—In this patient, the clinical picture was clearly that of uræmia and the blood urea nitrogen as well as the indigo-carmin test only bore out the clinical impression. Unfortunately we are not able to distinguish the uræmic clinical picture when it is still in embryo, and it is under such circumstances that the tests will often help, if properly interpreted. Whether this patient's life could have been prolonged by a bilateral nephrotomy, is impossible to say. Her condition at operation was so poor that a bilateral operation could not be done.

CASE XV.—A. Z., aged thirty-eight years. Admitted December 23, 1915.

*Diagnosis: Left ureter calculus; left pyonephrosis; right calculous pyonephrosis.*

Fifteen years ago left renal colic. Five years ago colic on right side. Colic on left side repeatedly.

December 18, 1915: Severe pain in left flank, with chilly sensations and fever. Marked frequency.

General condition, on admission, good; temperature up to 102.4° F. Both kidneys enlarged, left kidney size of child's head and tender. Urine contains albumin and pus.

Right kidney—Urea, 1.5 per cent.; much pus. Left kidney—

Thick pus comes from ureter which is obstructed at thirteen centimetres. Wax bougie negative.

*Indigo-carmin test* (No. 1). Faintest excretion in fifty-eight minutes from right kidney; none from left.

December 23, 1915: Blood urea nitrogen, 18.2 milligrammes; incoagulable nitrogen, 43 milligrammes per 100 cubic centimetres.

X-ray examination shows a large stone filling pelvis of right kidney; a small stone in left kidney, and a larger one in left ureter over the sacro-iliac synchondrosis corresponding to the obstruction in left ureter at 13 centimetres.

Blood pressure: systolic, 100 millimetres; diastolic, 70 millimetres.

December 28, 1915: *Phthalein test* (No. 1). Traces excreted.

December 29, 1915: *Phthalein test* (No. 2). Output, a trace.

December 29, 1915: Left ureterotomy for stone; left nephrotomy for pyonephrosis. Gas and oxygen anæsthesia. Left kidney converted into a large sac.

December 31, 1915: *Phthalein test* (No. 3) on bladder urine, which is almost entirely secretion of right kidney. Total output, 5 per cent.

January 2, 1916: *Phthalein test* (No. 4). Right kidney, total output,  $7\frac{1}{2}$  per cent.

January 4, 1916: *Phthalein test* (No. 5). Right kidney, total output, 6 per cent.; left kidney, trace.

January 11, 1916: *Phthalein test* (No. 6). Output, 5 per cent.

January 17, 1916: *Phthalein test* (No. 7). Output, 19 per cent. in four hours, right kidney.

February 2, 1916: Pyelotomy for right pyonephrosis under gas and oxygen. Very little parenchyma in this kidney.

February 12, 1916: *Phthalein test* (No. 8). Output, 30 per cent. in four hours, right kidney; left kidney drainage a trace.

January 2, 1916, to February 12, 1916: Urea output varied from 0.1 per cent. to 1.2 per cent. concentration in twenty-four hours. Total output of urea varied from a fraction of a gramme to 12 grammes.

February 14, 1916: Uneventful recovery.

*Summary.*—It is evident that in this case of bilateral disease, despite low output, no improvement in function was possible without direct attack on the kidneys. To remove all inhibitory influences, toxic or reflex, as well as to save whatever parenchyma there was in the left kidney, this side was operated upon first. After this operation there was a slight improvement in the output of the other kidney which apparently was doing most, if not all, the excretory work of the patient. Despite the low output, a pyelotomy was successfully done, on the second kidney,

## FUNCTIONAL RENAL TESTS

with marked improvement in total output. In other words, the intrinsic causes of low output being removed, there followed a marked improvement in kidney function.

CASE XVI.—L. H., aged fifty-six years. Admitted November 2, 1915. Discharged January 20, 1916.

*Diagnosis: Bilateral nephrolithiasis.*

In 1901 right nephrolithotomy. In 1912 left nephrolithotomy. Stones have recurred on both sides. Has had repeated attacks of pyelonephritis on both sides. Last attack was very severe, with high temperatures. Following this entered hospital for relief of pain and removal of stones. On admission patient in fair condition, anæmic. Tenderness over both kidneys.

November 3, 1915: *Phthalein test* (No. 1). Output, 5 per cent. Right kidney—Urea, 0.5 per cent.; pus, red blood-cells, albumin heavy trace. Left kidney—Urea, 1.0 per cent.; pus, red blood-cells, albumin heavy trace.

X-rays show very large stones in left kidney; large stone in right kidney.

Blood urea nitrogen, 18.2 milligrammes; incoagulable nitrogen, 27.2 milligrammes per 100 cubic centimetres.

*Indigo-carmin test* (No. 1). In two hours very faint excretion. Blood pressure: systolic, 120; diastolic, 70.

November 5, 1915: Twenty-four-hour specimen, urea, 0.7 per cent., total 42 ounces.

November 6, 1915: Nephrolithotomy (left kidney), under gas and oxygen.

December 13, 1915: Uneventful recovery. Left kidney is discharging all its urine through wound.

*Phthalein* (right kidney) *test* (No. 2). Only traces excreted.

December 24, 1915: *Phthalein* (right kidney) *test* (No. 3). Traces excreted. Dressings of left kidney well colored with phthalein.

Blood urea nitrogen, 16.1 milligrammes; incoagulable nitrogen, 45.4 milligrammes per 100 cubic centimetres.

Alveolar  $\text{CO}_2$  = 3 per cent.

Patient left the hospital and is to return for a right nephrolithotomy.

February, 1916: Right nephrolithotomy under gas and oxygen; uneventful recovery. Phthalein rose to 30 per cent.

*Summary.*—In this case of bilateral very large stones, there was no chance of restoring or improving the kidney function unless the intrinsic causes of the trouble were removed. Consequently the better organ was first attacked without any uræmic manifestations following

the operation despite the minimal output of test substances. After the operation the function of this organ improved markedly.

CASE XVII.—R. G., aged thirty-two years. Admitted October 8, 1912, and frequently readmitted up to the fall of 1915.

*Diagnosis: Bilateral nephrolithiasis.*

October 12, 1912: Right nephrotomy for calculous pyonephrosis.

November 12, 1912: Right nephrectomy.

September 18, 1914: Anuria due to left calculous pyelonephritis. Left nephrotomy and partial decapsulation for suppurative calculous pyelonephritis.

Wound healed. Patient well for a time. Stones reformed and many were passed. Repeated attacks of mild pyelonephritis.

March 11, 1915: *Phthalein test* (No. 1). Output, 20 per cent. Occasional rises in temperature with left lumbar pains and much pus in urine suggested a subacute pyelonephritis due to calculi (X-ray positive).

Blood urea nitrogen, 19.6 milligrammes; incoagulable nitrogen, 50 milligrammes per 100 cubic centimetres.

March 26, 1915: *Phthalein test* (No. 2). Output, 5 per cent.

March 27, 1915: *Phthalein test* (No. 3). Output, 5 per cent.

March 30, 1915: *Indigo-carmin test* (No. 1). Faint excretion.

April 6, 1915: Blood urea nitrogen, 30.8 milligrammes; incoagulable nitrogen, 47 milligrammes per 100 cubic centimetres.

April 8, 1915: Left kidney markedly enlarged and tender.

April 9, 1915: Extravasation of urine in left side. Area incised and drained (gas and oxygen anæsthesia). Kidney had apparently ruptured through old nephrotomy scar.

April 13, 1915: *Phthalein test* (No. 4). Total output, 5 per cent. The only evidence of uræmia throughout this period was frequently repeated vomiting.

April 19, 1915: *Indigo-carmin test* (No. 2). Appearance in forty-five minutes very faint. An hour later slight increase in concentration, one hour later very faint again and after another hour no color.

May 12, 1915: *Phthalein test* (No. 5). Output, 5 per cent.

June 5, 1915: Patient again developed a fulminating infection of her kidney and a second nephrolithotomy and decapsulation for suppurative calculous pyelonephritis was performed, under spinal anæsthesia.

Recovery from operation without uræmia.

June 16, 1915: *Phthalein test* (No. 6). Output, 6 per cent.

July 23, 1915: It was determined to keep a permanent tube in the kidney sinus, as a safety valve, in case new stones tended to form, as well as to medicate the pelvis.

*Phthalein test* (No. 7). Output, 7 per cent.

## FUNCTIONAL RENAL TESTS

July 26, 1915: *Phthalein test* (No. 8). Output, 20 per cent. in four hours.

August 5, 1915: Discharged relieved.

August 13, 1915: Anuria. Ureter catheter passed to pelvis and purulent urine obtained. Old lumbar incision, which had been allowed to close, was reopened under gas and oxygen and tube drainage reintroduced.

August 17, 1915: Blood urea nitrogen, 130 milligrammes; incoagulable nitrogen, 187 milligrammes per 100 cubic centimetres.

August 18, 1915: *Phthalein test* (No. 9). Less than 5 per cent.

August 20, 1915: Blood urea nitrogen, 30 milligrammes; incoagulable nitrogen, 77 milligrammes per 100 cubic centimetres.

September 28, 1915: *Phthalein test* (No. 10). Only traces.

October 24, 1915: *Phthalein test* (No. 11). Only traces in four hours.

November 19, 1915: Discharged. Patient is up and about.

February 10, 1916: Condition about the same. Has had occasional attacks of colic with fever. Drains through her sinus whenever the ureter gets plugged. Has lost weight and strength.

March, 1916: Third nephrolithotomy, decapsulation and drainage for stone recurrence. Gas and oxygen; uneventful recovery.

June, 1916, patient in better condition than she has been at any time since 1914.

*Summary.*—This extraordinary case shows how a patient with a solitary diseased kidney can stand a whole series of operations on that kidney under spinal anaesthesia, or gas and oxygen, even though the output of the test substances is minimal and the blood retention is increased, without going into a fatal uræmia. Despite the minimal excretion, which temporarily improved after the second nephrolithotomy, this patient has been under observation for ten months without developing fatal uræmia. The cause of her trouble is definitely intrinsic, and only by attacking this directly could improvement of function and prolongation of life be expected.

## CONCLUSIONS

I. Extrinsic causes (usually obstructive in character) may lead to permanent symmetrical renal damage, evidenced by minimal or zero excretion of phthalein and indigo-carmin associated usually with high blood urea and high incoagulable nitrogen blood content. Operation in these cases will be of no permanent benefit, and even the slightest (in one case the passing of a cystoscope) may bring on a fatal uræmia (Group A).

2. Similar extrinsic causes may lead to temporary renal damage evidenced by the same phenomena as under 1. Operation in these cases, particularly after adequate preliminary treatment, will be rarely followed by uræmia (Group B).

3. These two wholly different types of cases can be differentiated by removal of the usual causative factor, *i.e.*, relief of the obstruction, either by use of indwelling catheter, or regular catheterization, or by preliminary cystostomy under local anæsthesia or gas. If the case is of the type under 1, no marked change in the renal output will result, whereas if the case is of the type under 2, the renal output will regularly improve.

4. A similar low combined output may be caused reflexly (inhibitive or toxic) by more or less extensive disease of one kidney, while the other kidney is adequate and improves in its function after removal of its diseased mate, or after relief of the pathological condition in its mate (Group C).

5. A low combined output may also be due to bilateral intrinsic causes<sup>o</sup> and improvement in these cases is possible only after operative attack on the kidneys, or the kidney, if single, under an anæsthetic which has no injurious effect on the diseased kidney parenchyma and provided no severe wound infection or other septic, etc., complications which overtax this parenchyma develop (Group D).

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<sup>o</sup> Unilateral in single kidney cases.

# TRAUMATIC INJURIES OF THE KIDNEY AND URETER \*

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INJURIES of the upper urinary tract are most often subparietal, subcutaneous or subdermal—not associated with external wounds—and are in the nature of contusions, lacerations, and ruptures. Injuries associated with external wounds are generally due to stabbing or shooting, though various other accidents have been recorded.

KIDNEY.—Summaries of cases of traumatic injuries of the kidney have been compiled by Delbet,<sup>1</sup> in 1901, Watson,<sup>2</sup> in 1903, Suter,<sup>3</sup> in 1905, Lardennois,<sup>4</sup> in 1908, and Connell,<sup>5</sup> in 1911, the last-named author adding to previous lists 147 cases, of which he found “either mere mention, or a more or less complete report,” thus bringing the number up to 875. Since the appearance of Connell’s paper, there seems to have been no exhaustive review of the literature so far as case reports are concerned, though a number of articles on the subject have appeared, recording one or more cases. The two largest single series which have come under my notice are those of Lüken,<sup>6</sup> who, in 1914, reported 47 cases, treated in the Leipzig Clinic (Trendelenburg Director), during the years 1895 to 1911, inclusive, and of Ponomareff,<sup>7</sup> who, in 1914, reported 57 cases, observed during the years 1898 to 1912, inclusive. I have found, dating from the appearance of Connell’s contribution, records of 224 additional cases. I do not wish, however, to convey the idea that no other cases have been reported, for the reasons already stated. These, with 8 cases which I shall add, bring the total number of reported cases of traumatic injuries of the kidney up to 1107. This is probably a fairly accurate estimate, inasmuch as it may be considered that the number of cases overlooked is perhaps more than counterbalanced by those, included in the summary, in which the recorded facts leave room for doubt as to the diagnosis.

*Causes of Injury.*—Lardennois<sup>4</sup> divides ruptures of the kidney into three general classes, which apply likewise to injuries other than those usually denominated as rupture: (1) Those due to *direct trauma* (kicks; blows; falls upon stones, beams, bars, etc.; being crushed between two wagons, by wheels, etc.; and other manifestations of direct force applied

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\* Read before the American Association of Genito-Urinary Surgeons, May 9, 1916.



over the region of the kidney). (2) Those due to *indirect trauma* (violent horse-back riding; falling on the feet). (3) Those due to *muscular action* (sudden springing backward; heavy lifting; sudden movements in the effort to catch objects or to dodge blows, etc.).

In 45 out of 770 cases reviewed by Lardennois,<sup>4</sup> the cause of rupture was found to be shock or blow upon the anterior abdominal wall, and in only 3 of these were other abdominal organs injured.

The fact that the blow or force does not need to be very severe in order to cause serious injury, even complete rupture, of the kidney, is demonstrated in a number of reported cases. Gargam,<sup>8</sup> for example, in 1881, cited a case in which rupture of the kidney resulted from the individual striking against a table. A similar case, in which the patient struck himself against a counter, was reported by Borzy,<sup>9</sup> in 1900. In Borzy's case hæmatoma was found, with a rupture, large enough for the insertion of a finger, in the lower half of the kidney. It was with difficulty that the cause of the injury was elicited when the patient was seen some time subsequently—the fact being taken to signify the trivial character of the accident.

A case, frequently mentioned, was cited by Voit, in which a woman, while dancing with her husband, who held her very tightly round the waist, felt a severe pain in her right side. Hæmaturia set in at once, was very abundant, and lasted two months, intermittently. At the end of this time the perirenal effusion began to suppurate. Lumbar incision for purposes of drainage revealed the fact that the kidney was ruptured. This case, sometimes mentioned as an illustration of rupture by muscular action, also suggests the presence of some concurrent contributory factor.

The following case, in my series, illustrates the point that relatively slight muscular action may result in injury to the kidney.

CASE I.—J. A., male, thirty-two years old; chauffeur, with negative family and previous personal history. In June, 1914, while bending down and cranking a car, patient felt a sharp pain in the left side of the abdomen, beneath the costal margin, became faint, and had to lie down. After a few minutes he was able to stand, and with assistance to go home. For two weeks he was unable to work as a chauffeur, owing to the pain in the side, when he tried to stand or move about. At the end of this period he did some work, but had to stop work and go to bed again. He then had a constant pain in the left side of the back, and began to run a temperature ranging from 100° in the morning to 103° at night.

Six weeks after the injury I saw the patient, and found on examination a large, firm, tender mass in the left lumbar region,

## TRAUMATIC INJURIES OF THE KIDNEY AND URETER

extending from beneath the costal margin to the crest of the ilium. The mass was slightly movable, and was easily felt anteriorly on bimanual palpation. The urinary examination was negative, as were likewise the cystoscopic examination and ureteral catheterization. The patient's temperature at this time was 103 degrees and the pulse 110. The diagnosis of hæmatoma secondary to laceration of the kidney, the result of muscular violence, was made, and operation advised.

I made a lumbar incision, and, upon reaching the perirenal fat, a large, broken-down hæmatoma was encountered. Nearly a quart of thick pus was evacuated, and a laceration found in the kidney, at the junction of the lower and middle thirds of the organ. The laceration extended down to but not into the kidney pelvis. There was still some oozing from the torn kidney surface. The wound in the kidney was packed with gauze and the lumbar incision closed about it. The patient made an uneventful recovery.

Subsequent analyses of separated urines have shown a functional capacity of the left kidney equal to one-half that of the right.

Here, then, was an extensive laceration of the kidney, due to muscular action of a moderate degree of violence, with extensive hemorrhage, but with no extravasation of urine and no changes in the urinary stream.

FAUNTLEROY,<sup>20</sup> in 1912, reported the case of a robust seaman, twenty-one years old, who had fallen a distance of two feet, while cleaning the forward turret of the ship, striking the left side of the abdomen against the ball attached to the stock of a small anchor which was lashed to the side of the turret. The kidney was exposed by a Mayo incision, whereupon it was found that there was still active hemorrhage, and on both the anterior and the posterior surfaces there was a large rent in the capsule and parenchyma extending, on both surfaces, from the convex border into the hilum. In addition to this, the central part of the viscus was soft and pulpy, rendering it impossible to suture the wounds, and necessitating nephrectomy.

ATKINSON,<sup>21</sup> in 1914, cited the case of a girl, fourteen years old, who, while running after a dog, ran across a fifteen-foot porch, into a light wire netting at the edge of the porch, and fell two feet, into a flower bed of soft earth. Despite the fact that the child could not have acquired a great momentum in the distance covered, severe symptoms immediately supervened, and operation revealed a laceration extending right through the kidney substance, the upper pole being much more severely injured than the lower.

A case similar to the preceding as regards the relatively trivial character of the accident, came under my observation in 1914.

CASE II.—J. W., male, aged six years. Family and previous personal history negative. In May, 1914, patient fell from a park bench, a distance of 2½ feet, striking on his left flank. He fainted, and was carried home. An hour later he passed urine

deeply colored with blood. He complained of pain in the left flank. When seen by a doctor marked tenderness was found in the left kidney region. Ice was applied, and the patient was kept quiet in bed. There was no elevation of temperature, no mass appeared in the side, and the hæmaturia diminished.

Two weeks later, when seen by the writer, the patient had been allowed to get up, and the hæmaturia had returned. At this time the patient presented a palpable left kidney, tender, but not irregular. No mass was felt outside the kidney. Ureteral catheterization showed a profuse left-sided hæmaturia, but otherwise no change in the kidney excretion. Under rest the patient made a complete recovery.

In this case the laceration of the kidney communicated with the pelvis of the organ, yet there was no rupture of the kidney capsule. No hæmatoma formed, and there was no infection.

It is interesting, in connection with the study of cases in which injury to the kidney resulted from very slight force, to note that most of such cases reported are in young adults and children, in some of whom, at least, there is a possibility of a causative factor in some abnormality of the abdominal viscera. The possibility of the persistence of infantile ptosis, as suggested by Aglave,<sup>12</sup> by leaving more of the surface unprotected by the thoracic bulwark, in the opinion of Gibson,<sup>13</sup> may account for some of the cases of renal traumatism in children. The particular vulnerability in childhood has also been ascribed to the minimum deposit of perinephric fat, according to Gibson, and the greater tension of the overlying peritoneum.

In the case cited by Atkinson<sup>11</sup> it was found, upon median sub-umbilical exploratory incision, that about midway between the cæcum and the splenic flexure there was a kink, formed by the lower end having a long mesocolon, allowing a partial volvulus. Just above this kink, and about on the level of the junction of the lower and middle thirds of the injured kidney, there was a transverse tear, about an inch long, into the lumen of the gut. Such cases suggest a line for further inquiry.

Gibson,<sup>13</sup> in four cases of complete rupture of the kidney in children, ranging in age from eight to twelve years, found a similarity in the lesions, which, with the fact that they were the same with different kinds of violence, seemed to him to confirm the theory of "bursting" by hydraulic pressure, as suggested by Küster.<sup>14</sup>

From his review of the literature and the tabulated statistics of 22 cases of rupture of the kidney in children, Gibson believes these injuries to be more common than is generally estimated.

Küster's hydraulic pressure theory, as is well known, was evolved

from experiments which consisted in distending the veins, arteries, and renal pelvis, then applying violence to the surface of the organ. Deep transverse lacerations, extending into the pelvis of the kidney, resulted. From these observations he concluded that the essential element in the production of rupture of the kidney is hydraulic pressure. This pressure, acting through the renal pelvis and blood-vessels, causes bursting of the viscus upon the receipt of a blow. The blow or other force may lead to rupture, whether it be applied directly against the back and ribs over the kidney, or indirectly from the anterior abdominal wall.

The rupture, according to Küster, is usually transverse, and takes place in the interlobular lines of the embryonic kidney. In Gibson's cases, however, the line of rupture was vertical to the long axis of the kidney, at about the junction of the two lower thirds. This would seem to indicate a different line of least resistance, such as Gibson had not seen mentioned in any of the treatises on the subject.

Morris<sup>15</sup> holds that the ribs play an important part in the production of traumatic injuries of the kidney. When the force is applied upon the back or sides it is directly transmitted to the kidney by the impact of the ribs upon this organ. When the force is directed upon the front of the abdomen it is indirectly transmitted, by impact of the ribs, to the kidney. In either case the kidney is driven against the unyielding vertebral column. It is more difficult, however, as Gibson has pointed out, to apply this explanation to those manifestations of indirect violence such as a fall on the feet.

The fact that the preponderance of cases of traumatic injuries of the kidney concern males in the prime of life, as compared with their occurrence in females of any age and in children, would seem to be explained on the basis of the exigencies of active life rather than of any inherent predisposing condition or disease.

The part played by general arteriosclerosis, syphilis, and other affections in predisposing to injury of the kidney by slight degrees of traumatism, has not been thoroughly investigated, so far as I am aware. It is conceded, however, that syphilis, arteriosclerosis, cancer, polycysts, and calculi may render the kidney more susceptible to traumatic injuries.

*Nature of the Injury.*—The injury to the kidney following traumatism of whatever kind may vary from tears of the fatty capsule, localized subcapsular hemorrhage, slight contusion or laceration of the parenchyma, to rupture of the pelvis of the kidney, injuries to the renal blood-vessels, complete rupture, single or multiple, or general pulpification, with or without complicating rupture of the peritoneum or injury to other structures.

Swainson,<sup>16</sup> in 1914, operated upon a child, six years of age, who had fallen down five wooden steps, sustaining a rupture of the kidney into three portions, held together slightly at the pelvis, which was itself torn. Stellate fractures are reported in a number of cases. Rupture, complete and incomplete, may be entirely intracapsular, as in Case II of my series. Rupture of a single or horse-shoe kidney was reported by E. O. Smith<sup>17</sup> in 1915. Twenty-two cases of injury of the renal blood-vessels were collected and reported by Vidakovic<sup>18</sup> in 1913, and one case of injury of the suprarenal capsule was reported by Canestro<sup>19</sup> in 1912. The right kidney is more often injured than the left. Bilateral injuries are rare. Franklin,<sup>20</sup> in 1912, reported a case in which the left kidney was "torn to pieces," and the right presented three transverse tears. The patient was a girl, sixteen years old, who had fallen from a wagon.

Habs<sup>21</sup> expressed the view that in all renal lesions there may be synchronous lesions of the peritoneum, the stomach, the intestines, the liver, and the spleen. If this be true, the aspect of the case would naturally be influenced thereby, and such a possibility should be borne in mind.

The experimental observations of Falcone<sup>22</sup> are interesting in this connection. He experimented upon eight dogs, reducing one kidney to a crushed mass. In the other kidney the results, in the first days after this operation, were extreme congestion, glomerular and interstitial hemorrhages, with oliguria, and the presence of albumin and white and red corpuscles. In the successive days the quantity of urine increased, the color improved, but the albuminuria nearly always persisted, in some cases with cylindruria. Falcone concluded from these observations that, while a strict clinical application to man is not possible—else the 25 per cent. mortality in man given by Legueu<sup>23</sup> would be higher—when any lesion is suspected in the uninjured kidney one should proceed without delay to remove the injured organ, since probably only by this radical means can the life of the patient be saved. These observations are worthy of further study.

*Symptoms.*—Shock, localized pain, tumor from hemorrhage into the perirenal tissues, hæmaturia, and changes in the quantity of urine, are the chief symptoms associated with injury of the kidney. The so-called classic symptoms (shock, pain in the lumbar region, and hæmaturia) are present in widely varying degrees of severity, and cases are recorded which emphasize the fact that all these symptoms may be absent for a varying length of time; also that one or more may be lacking throughout. In a case reported by Sears<sup>24</sup> nothing occurred

for several days to direct attention to the kidney, despite the fact that an injury sufficiently severe to practically pulpify the kidney was found at autopsy. In Fauntleroy's case,<sup>10</sup> mentioned above, the symptoms were meagre. The following may be cited as a typical case, the injury being complete subparietal rupture of the kidney.

CASE III.—The patient was a boy aged fifteen years. His history previous to February 19, 1910, was negative. On this day, while coasting, his sled turned, throwing him violently against an iron post. The blow was received squarely between the ribs and the crest of the ilium. He complained of severe pain in the side, but was examined by a physician, who expressed the opinion that he would be all right in a few days. Two hours after the accident he passed an ounce of bloody urine, and this was repeated an hour later. His condition became alarming, and a second physician was called in, who advised his removal to the hospital.

I saw him nine hours after the receipt of the injury. He was then pale, cold and clammy, covered with sweat; the pupils were dilated; respirations gasping; pulse thready and irregular; temperature 97°. In other words, he was in profound shock. The right side of the abdomen was filled with a rather firm, rounded, slightly movable, tender mass. The remainder of the abdomen was distended, and the right half was tender. The diagnosis of rupture of the right kidney was made. The firmness of the mass indicated a hæmatoma and the absence of intraperitoneal injury.

After expectant treatment for several hours, during which time the patient's condition did not improve, an intravenous saline injection was given, and a rapid posterior exposure of the kidney was made. The kidney was found to be completely ruptured, transversely, the line of fracture involving the renal pelvis and vessels. The loin was filled with blood, urine and clots, which were cleared out. The pedicle was rapidly ligated and the kidney removed. The patient rallied at once, the remaining kidney functionated normally, and the convalescence was uneventful, the patient leaving the hospital at the end of six weeks.

The degree of *shock* present depends upon the amount of hemorrhage; also upon whether the injury to the kidney is complicated by injury of the peritoneum and other organs. It is held by some observers that the fatty capsule of the kidney tends to control the hemorrhage, and consequently influences the degree of shock.

Bloch,<sup>25</sup> in 1914, reported a case in which shock was apparently entirely absent. The patient, a boy of seventeen, walked into the doctor's office with the statement that he had struck his left loin against

the corner of a table, and that shortly thereafter had voided bloody urine. Careful examination revealed no cut, scratch, swelling, or other external indication that he had received an injury. His only symptom was hæmaturia. Exposure of the left kidney, after forty-eight hours of expectant treatment, revealed a large amount of extravasated blood, and a laceration of the kidney on its convexity of about two-thirds of its length, the laceration extending in depth about one-half of the kidney substance.

In some instances the shock is transitory, and failure to elicit a history of this symptom is doubtless sometimes due to this fact, especially if the injury is associated with considerable hemorrhage.

Intense lumbar *pain*, which is one of the characteristic symptoms, is very severe at first, as a rule increasing in intensity during the first hour after the injury, probably as the result of the consequent and increasing effusion of blood, and the infiltration of urine into the perirenal tissues. Not infrequently the pain, severe at first, decreases or entirely disappears. In some cases of severe kidney lesions pain is never a manifest symptom. In the case reported by Sears<sup>24</sup> pain in the lumbar region was never present.

An important characteristic, noted by Habs, where hæmaturia is not present, is that pain radiates down from the lumbar region to the scrotum, the penis, and even to the thigh, due, presumably, to pressure from the effused blood on the nerves supplying this region. In one of the cases reported by Habs this was the only characteristic symptom.

The presence of a *tumor* in the renal region in cases of traumatic injury of the kidney depends, in many cases, upon the extent and localization of the hemorrhage. It may be due, as in cases reported by Perriol and Bosquette,<sup>26</sup> Mincer,<sup>27</sup> Wildbolz,<sup>28</sup> and others, to hydro-nephrosis or pseudohydronephrosis.

The fact that the tumor may be intermittently apparent, and that this state of affairs may extend through a number of years following traumatism in the loin, with presumptive injury to the kidney, is illustrated in the following case:

CASE IV.—F. V. T., male, aged fifty years. Thirteen years before admission to St. Luke's Hospital (April, 1916), the patient, while lifting a hog, was kicked in the left side. After this he had pain in this region, followed by the appearance of a "lump," which increased in size. He went to a hospital, where he was treated expectantly for three weeks. At the end of that time, according to his history, he felt something give way, whereupon he voided material which was very dark in color. The lump then

decreased in size. Since that time the mass has been intermittently larger and smaller. When it decreases in size the urinary output is increased. He has had occasional attacks of pain in the lumbar region, sometimes in the nature of an ache, at others it has been sharp and knife-like. There has been no hæmaturia since he left the hospital, three weeks after the injury. Following a recent attack of grippe, he experienced pain and tenderness in the left side, and was then admitted to the hospital.

Examination revealed the presence of a tumor in the left kidney region. Upon cystoscopic examination the bladder was found to be normal, except for slight congestion. Ureteral catheterization yielded concentrated, clear urine from the right side; from the left side, the urine was dark and cloudy, and flowed more freely upon pressure on the tumor mass, the mass, meanwhile, diminishing in size. The urine from this side contained much pus, and showed very little functional capacity of the left kidney. The diagnosis of laceration of the left kidney, due to the blow in the loin, was made, with the development of a hæmatoma, the breaking down of the hæmatoma, and the subsequent degeneration of the kidney. The patient refused operation.

*Hæmaturia* has been considered by Kocher and a number of other observers as the cardinal symptom of renal lesions. Vielcker,<sup>20</sup> on the other hand, considers this an uncertain sign, not so reliable as the detection of retroperitoneal tumor, ecchymosis in the inguinal or scrotal region, or the indications of peritoneal tear. The danger of depending upon this sign, or rather the danger of being misled by its absence, is emphasized by numerous cases.

Stoney,<sup>20</sup> in 1910, reported a case in which a man, twenty-eight years of age, was thrown from a bicycle, alighting on his shoulder. He was unconscious for a few moments, then went home. He remained in bed for two weeks, during which time he complained of pain in the right side. Not until he got up again did he notice blood in the urine. He then went to a hospital, where he was under observation for three weeks. The urine now contained a quantity of blood, which the Luys segregator showed to come from the right kidney. At operation it was found that the kidney was almost torn in two at the hilum, the lower half being in a state of pulp.

In a case reported by Ehrenpreis,<sup>21</sup> of complete rupture of the kidney in a man of twenty-eight years, resulting from a fall from the seat of a carriage, hæmaturia did not appear until the tenth day after the accident. In the case reported by Sears,<sup>21</sup> the urine, while high-colored and of high specific gravity, and decidedly acid, presented no macroscopic evidence of blood until the fifth or sixth day. The quantity of blood then increased rapidly, and clots filled the bladder to such an extent that a more or less firm tumor could be easily outlined in the lower abdomen. In this case, it will be remembered, autopsy showed a pulpified condition of the kidney.



In Case IV of my series, hæmaturia was present only once, three weeks after the injury, during a history of thirteen years.

The absence of hæmaturia in a case reported by Greensfelder<sup>32</sup> was accounted for by the presence of a clot in the pelvis of the kidney which prevented the urine or blood and urine from passing down the ureter.

Johnson<sup>33</sup> calls special attention to cases of traumatic renal affections in which the hæmaturia is intermittent, and describes a parenchymatous hæmatoma, the capsule of the kidney being intact. In the following case from my series hemorrhages into the cortex of the injured kidney were demonstrated.

CASE V.—H. L., female, aged twenty years. Two weeks before admission to the hospital patient fell out of bed, giving her body a sharp twist. Since that time she has had pain in the left lumbar region. Four days after the fall she had a chill, fever, vomiting, slight hæmaturia, and continued severe pain in the left kidney region. Tenderness of the lower pole of the kidney, which was palpable, was elicited. No tumor was demonstrable, and the kidney was apparently not enlarged. Urethra, bladder and ureters normal. Upon ureteral catheterization, urine from the right kidney was found to be acid, there was transitory albuminuria; leucocytes few; function normal. Urine from the left kidney was neutral, with transitory albuminuria, few leucocytes and red blood-cells, some epithelial cells; function diminished. X-ray examination revealed a definite kidney outline, of regular contour, with an increased density of the kidney shadow, particularly of the lower pole.

The symptoms of pain and tenderness diminished after a week of rest in bed. The patient left the hospital, and it has not been possible to follow the after-history.

In this case, as in many others which do not come to operation, it is not possible to make an absolute diagnosis, but the findings—history of injury, localized symptoms, tenderness of the kidney, hæmaturia, diminution of function, increased density of kidney shadow—seemed to be sufficient to warrant the diagnosis of intrarenal hemorrhage, with slight laceration of the pelvis and no break in the capsule of the kidney.

Many of the cases reported in the literature emphasize the fact that very slight symptoms do not preclude the possibility of severe or even fatal hemorrhage; and that the intensity of the hæmaturia is not always in relation to the gravity of the lesion, as pointed out by Legueu,<sup>23</sup> Cathelin,<sup>34</sup> and others. It is well known that very slight injury may cause severe hemorrhages in cases in which the injured kidney is the seat of polycystic formations, of malignant neoplasms, and of calculi.

On the other hand, it is not to be overlooked that a perirenal or renal hæmatoma may become organized. Gyselynck<sup>35</sup> cites such a case in which, a year and a half after the injury, the kidney was found to be the seat of a tumor the size of the fist, situated on the posterior surface. The tumor was in reality a cystic pouch formed from the tissue of the kidney, which had become enlarged. It contained liquid blood and a quantity of coagulum that appeared to constitute veritable tissue. The following case from my series is an illustration of this possible outcome:

CASE VI.—H. D., male, aged twenty-nine years. While playing foot-ball, in 1909, the patient was accidentally kicked in the left side of the abdomen, just below the ribs. This area was tender for several months, and he had an occasional attack of dull, aching pain over the left kidney, which persisted, at intervals, until 1913, when I first saw him. He had had no urinary symptoms. Upon examination a moderate increase in the size of the left kidney was detected, the lower pole of which was easily palpable. The kidney was tender on bimanual palpation. A radiograph showed an irregular area (not a definite shadow), in the lower pole of this kidney, of varying and greater density. Ureteral catheterization showed slight decrease in the function of this as compared with the right kidney; otherwise, was normal. Combined radiographic and cystoscopic examination gave no irregularity in the outline of the pelvis, and the dense area (thickened kidney) was not in immediate contact with the pelvic margin. No operation was performed, but the findings indicated an organized hæmatoma in the lower pole of the kidney, caused by the injury. The hæmatoma did not communicate with the pelvis of the kidney, hence no urinary symptoms were present.

*Changes in the quantity of urine* (oliguria, anuria, polyuria) are perhaps more variable than the so-called cardinal signs of traumatic injury of the kidney. With a history of trauma of such nature as to probably involve the kidney, changes in the quantity of the urinary output are to be taken as significant of injury to the upper urinary tract.

*Complications and remote results* are always to be reckoned with as possibilities in connection with traumatic injuries of the kidney. Secondary hemorrhage, suppuration, pseudohæmatonephrosis, hydronephrosis, intraperitoneal hemorrhage, nephritis, cysts, calculi, and perhaps malignant neoplasms may be associated with or may follow as a result of traumatic injuries of the kidney. Wildbolz<sup>28</sup> collected 17 cases of traumatic hydronephrosis. Köhler<sup>36</sup> reported a case of floating kidney resulting from trauma; renal calculi following injury to the

kidney have been reported by Casper<sup>37</sup> and others, and instances of the development of malignant neoplasms in the kidney subsequent to the injury have been reported by Theilhaber,<sup>38</sup> Beneke and Namba,<sup>39</sup> and Tscherning<sup>40</sup> among others. In the following cases of my series movable kidney was a result of injury:

CASE VII.—J. C., male, aged fifty-one years. Previous history excludes the kidney from consideration. Two months before admission to the hospital, in an automobile accident, patient was struck in the left side by a mud-guard. He was unconscious immediately after the accident, but experienced no other trouble until two months later, when he began to have an aching and persistent pain in the left side of the back, which was relieved by lying down. These attacks were followed by the passing of large quantities of urine. There had been no change in the appearance of the urine. Examination revealed palpable, movable left kidney; right kidney apparently normal. Cystoscopic examination and ureteral catheterization showed, when combined with X-ray examination, a prolapsed kidney, but no other pathological condition. The symptoms were relieved by applying an abdominal belt and pad for the left kidney.

CASE VIII.—P. W. H., male, aged thirty-six years. Eleven years before he came under my care, patient fell from a fire escape, striking the right side of the abdomen, midway between the ribs and the crest of the ilium. Hæmaturia followed the accident, and lasted four days. Since the accident he has had more or less constant dull pain just below the right costal margin. He has had no further urinary symptoms, and has been in good general health. Upon examination, a small movable mass was palpable under the right costal margin, undoubtedly the kidney. Cystoscopic examination and urethral catheterization revealed a deficient and movable right kidney, but the urine contained no pathological elements. A pyelogram showed an obliteration of the lower calyx, and an indefinite, faint, irregular shadow, involving the lower pole of the right kidney, with no changes in the size or outline of the renal shadow—presumably a cicatrix resulting from laceration at the time of the injury, eleven years before.

The pyelogram in this case is similar to one taken recently in which the kidney, twelve years previously, had been split and a section removed.

*Diagnosis.*—One or more of the typical symptoms will be elicited, if carefully sought for, in the majority of cases, though, as we have seen, apparent exceptions have been recorded. With the history of a blow on the side or back, shock, pain, tumor, and hæmaturia, the diagnosis

is plain. In the absence of tumor, hæmaturia will probably be present, and the investigation of this will reveal the cause.

Not all cases, however, as we have seen, are typical, presenting the classic or cardinal symptoms in such degree and sequence as to lead to a positive diagnosis of injury to the kidney. The difficulties often increase as the time between the accident and the examination lengthens.

When the diagnosis cannot be conclusively established from the clinical signs, one or more of the various aids to diagnosis should be employed. Cystoscopy, ureteral catheterization, microscopic examination of the urine, pyelography, and radiography are to be considered in this connection.

Pyelography has been advocated by Lockett and Friedman<sup>41</sup> as a means whereby positive information may be obtained, and by which one may determine how much laceration has occurred to the kidney substance, whether it is an intracapsular injury, or whether the capsule has been torn through, the determining factor being the dissemination of collargol (injected through the ureter) within the kidney substance or outside of it, as shown by the radiograph. This leads to conclusions as to whether surgical interference will be imperative without waiting for secondary symptoms as an indication for such interference.

Florence and Ducuing<sup>42</sup> have suggested, in connection with a case in which the diagnosis was difficult, the diagnostic value of exploratory puncture of the cul-de-sac of Douglas, by way of the perineum.

Heitz-Boyer<sup>43</sup> made the diagnosis of traumatic nephritis by means of examination with experimental polyuria and the ascertaining of the urea normal of Auerbard.

In some cases a positive diagnosis, especially with reference to the extent of the injury, can be made only by means of exploratory laparotomy or lumbotomy. Resort to this more radical method of diagnosis should be prompt in the face of urgent symptoms, the exact origin of which cannot otherwise be determined.

*Treatment.*—After reviewing the opinions of a number of experienced observers Lüken<sup>6</sup> concludes that there is no uniformity in the matter of treatment of traumatic injuries of the kidney, except that all decide on operation where life is in danger from primary hemorrhage or infection arising at the wound focus. My own review of the literature leads to virtually the same conclusion. However, whether the treatment be expectant, conservative surgical (exploration, drainage, suture, or partial excision), or radical surgical (nephrectomy), each case must be considered individually. It goes without saying that it is desirable, wherever this is possible, to leave the patient with two functionat-

ing kidneys rather than one, and where this cannot be done, to conserve as much as possible of healthy kidney tissue. Early and positive diagnosis is the most potent factor in the attainment of this end. While it is true, as many writers have stated, and as at least two cases of my series (Cases VI and VIII) seem to indicate, that spontaneous cure can and does take place, too many chances should not be taken with Dame Nature, who is apt to be rather whimsical in the application of her boasted healing power. Whether expectant treatment or conservative methods be employed, we should take care that we are not subjecting the patient to the possibility or the probability of the subsequent destruction of the kidney, in part or in the whole, from infection of the kidney substance itself or of a hæmatoma.

URETER.—Morris,<sup>44</sup> in 1884, stated that he saw no reason for considering the subject of traumatic injuries of the ureter apart from the kidney, because, as he said, "in the very few cases on record the rupture of the ureter was quite close to the renal pelvis, and it was neither practicable nor requisite from the point of view of treatment to distinguish between subcutaneous rupture of the renal pelvis and subcutaneous rupture of the ureter." He further stated that only three cases of penetrating wounds of the ureter had been published, at least one of which was doubtful. He concluded "that the diagnosis, symptoms, sequelæ, and treatment of injured ureter in no way differed from those of ruptured or wounded kidney." His estimate of the subject at that time was based upon the records of 13 cases of subcutaneous rupture of the ureter and 3 cases of penetrating wounds.

From the appearance of his earlier communication up to 1901, Morris<sup>16</sup> found 8 additional cases purporting to be subcutaneous injuries of the ureter. These cases, however, were not all cases of injury of the ureter proper, and they did not give him grounds for changing his opinion expressed in 1884. Because of the growing importance attached to the surgery of the ureter he considered the subject separately in the 1901 edition of his book. Of the 24 cases reviewed by him at that time, he considered only 12 as injuries of the ureter proper.

Blauel,<sup>45</sup> in 1906, found only 12 cases of subcutaneous injuries of the ureter. Since 1906 I have been able to locate only 7 cases, including the one given below.<sup>45-51</sup>

CASE IX.—Male, forty-six years of age. The patient came under my observation in November, 1907, with the following history: Three years before he had fallen from a ladder, striking on the left side of the abdomen, the force of the blow coming unduly between the last rib and the crest of the ilium. The pain

was severe, and radiated to the left groin and testicle. He vomited. He noticed no blood in the urine, but there was a diminution in the amount passed. Several days later a swelling appeared in the left side of the abdomen. This had never disappeared, and had become larger. He had had almost constant pain in the side; no chills, fever, or extreme tenderness. His general health had failed, and he had been under medical care, with no relief.

Upon admission to the hospital, physical examination was negative except for a smooth, tense, slightly tender mass, somewhat movable, in the left side of the abdomen. Examination of the urine was negative. The tumor was exposed through an oblique kidney incision. It was found to be a hydronephrotic kidney, of three distinct lobulations. The thin cyst wall (thinned-out kidney parenchyma) was smooth on the surface. The whole mass extended from the crest of the ilium up under the ribs. It was adherent to the peritoneum and adjacent structures, and was freed with much difficulty. In freeing the lower pole of the mass it was ruptured, allowing the escape of eighteen ounces of thin, odorless, yellow fluid. The ureter was exposed, lying to the inner side of the mass. Two inches from the pelvis of the kidney the ureter presented a dense stricture. The stricture was fibrous in character, and prevented the passage of fluid from the kidney. There was no kink in the ureter. The kidney was removed. There was no evidence of injury to the kidney, of a calculus, or of a growth. The trouble, it is fair to assume, dated from the injury; the history, and the appearance at operation, clearly indicated a traumatic stricture of the ureter, with consequent hydronephrosis. The right kidney functionated perfectly throughout. The patient was under my care for six weeks, and was discharged healed and cured. He has been well since.

This case may be said to be typical, in so far as cases of traumatic injury of the ureter alone are ever so, for it is generally conceded that there are no definitely characteristic symptoms in these cases. Pain and tenderness over the loin or abdomen, the presence of a tumor, and the history of injury may suggest rupture of the ureter, but they are likewise suggestive of injury of the kidney. Hæmaturia may be present in slight degree, it may be entirely absent, or it may be transient. The pain may subside after a time, and not appear again until it becomes associated with the presence of the tumor, the manifestation of which may be noted within a few days or not for several years, according to some of the writers on the subject.

There seems to be no dependable method whereby injured ureter

with extravasation may be differentiated from injured renal pelvis with extravasation. Inasmuch as the treatment is the same, this lack of differential diagnosis is of little moment.

Dumitresco,<sup>46</sup> in reporting a case of traumatic rupture of the ureter, considers the diagnosis as twofold: (*a*) The diagnosis properly so-called, depending upon whether the patient has been seen directly after the accident or not until several days after; (*b*) differential diagnosis, from: (1) simple contusion in the region of the ureter; (2) rupture of the kidney and kidney pelvis; (3) rupture of the bladder.

Immediate catheterization and examination of the urine is important in establishing the diagnosis; cystoscopy will show the side injured; and ureteral catheterization will reveal the condition of the opposite side.

The management of cases of ureteral injury, like those of injury of the kidney, calls for exploratory incision if the symptoms do not promptly subside upon expectant treatment. When the exact conditions are thus determined, the treatment, of course, must be applied according to the needs of the individual case. This may consist of drainage, of suture, or repair by whatever method is preferred, of anastomosis, or of nephrectomy.

#### CONCLUSIONS

From a review of the literature concerning traumatic injuries of the upper urinary tract and of the available reported cases, it may be fairly concluded:

(1) That the small number of recorded cases of traumatic injuries to the kidney and the ureter, as compared with traumatic injuries in general, may be accounted for in part by the failure to make a correct diagnosis, and in part by the fact that many cases are dismissed as cured following a period of rest and expectant treatment, with temporary amelioration of symptoms.

(2) That a careful "follow up" system would doubtless throw a different aspect over many of the cases treated expectantly and dismissed as cured, as with 3 of my series.

(3) That, in all probability, many cases of the vague symptom-complex, neurasthenia, might be cleared up by a more careful study of the history and the symptoms in relation to the possibility of traumatic injuries of the urinary system, especially the kidney.

(4) That in no case, where any of the evidence directs attention to this part of the body, should too much dependence be placed in the cardinal symptoms, as to their absence or their presence.

(5) That prompt and painstaking diagnosis, and the application of

## TRAUMATIC INJURIES OF THE KIDNEY AND URETER

treatment in accordance with the exigencies of each case, will tend to lessen the mortality and the remote results of the injury, and will lead to the conservation of functioning kidney tissue in many cases in which ultimate nephrectomy would otherwise be necessary.

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## OS CALCIS FRACTURE\*

BY FREDERIC J. COTTON, M.D.

OF BOSTON

IN presenting this paper to the Association, I am moved by both pride and chagrin. Eight years ago I published a paper on this subject, which I have reread recently; it contains so exactly what I believe to-day that I am embarrassed. Either I was then and am now entirely wrong, or else the profession continues to be entirely wrong now, after due warning.

For one thing seems certain: outside the staff of my own hospital, no one has paid the least attention. I'm going to do it again, and try to do it better.

In the first place, the lesion itself has not been understood—the crushing and spreading character of the damage; it is not a clean-cut break. The X-ray shows only a confusion of interrupted lines that mean nothing. Cabot and Binney and others have tried to formulate and classify these fractures. This is about as useful as classifying cracks in a walnut, after the nut-cracker is through with it! The heel-bone is mashed down, and there are all sorts of lines to be found. This is well enough illustrated in these plates (Fig. 1).

Be it said in passing that we have no concern with cases of avulsion of a fragment of bone, through pull on the Achilles tendon, a different lesion entirely, so rare that I have personal knowledge of but three cases, and none at all in the hundred odd that have come to my direct attention.

Our class to be considered now are the cases in which the patient lands on his heel and mashes it down. As it mashes down, obviously the rear end of the calcis is pushed up a bit, more or less, in one case and the other; the bone is decreased in its vertical depth (Figs. 2 and 13); also (and more important, as shall presently be shown) its lateral diameter is always increased, and often greatly increased. This increase is more particularly due to a bulging *outward* under the external malleolus (Fig. 3). The specimen shown in this plate serves to show why this is so (Fig. 4). The late Dr. Louis Wilson and I got hold of it, when we first were working on os calcis fractures. It was in no way unlike the average case, save that infection, through a slough, led to amputation; hence the specimen. I know of no other fresh specimen studied out.

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\* Read before the American Surgical Association, May 11, 1916.

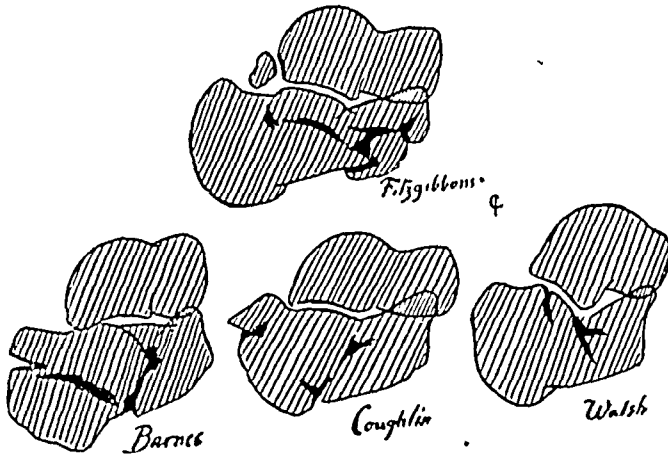


FIG. 1.—Sketches from X-rays in author's collection—fracture of os calcis of various types or lack of type. The upper figure shows fracture of the "apophysis" at the back, also.

Kaplan  
1813.5



FIG. 2.—The vertical diameter of the bone is notably decreased. Skiagraph of a healed fracture shows also, anteriorly, a deeply projecting spur that must give troublesome pressure in the sole of the foot.



FIG. 3.—Shows the projection of outwardly displaced bone fragments close up under the external malleolus. The point X is as far out as the malleolus, Y, instead of one-half to three-quarters inch deeper in. This distortion is very evident on palpation.

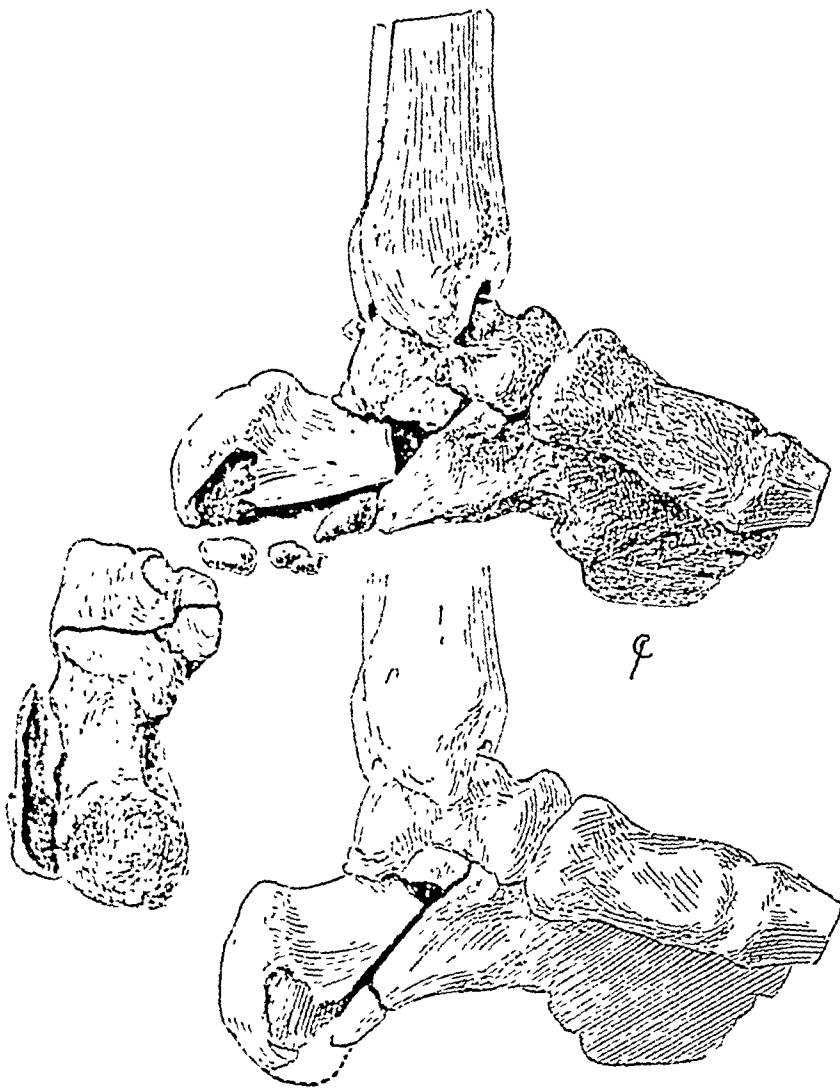
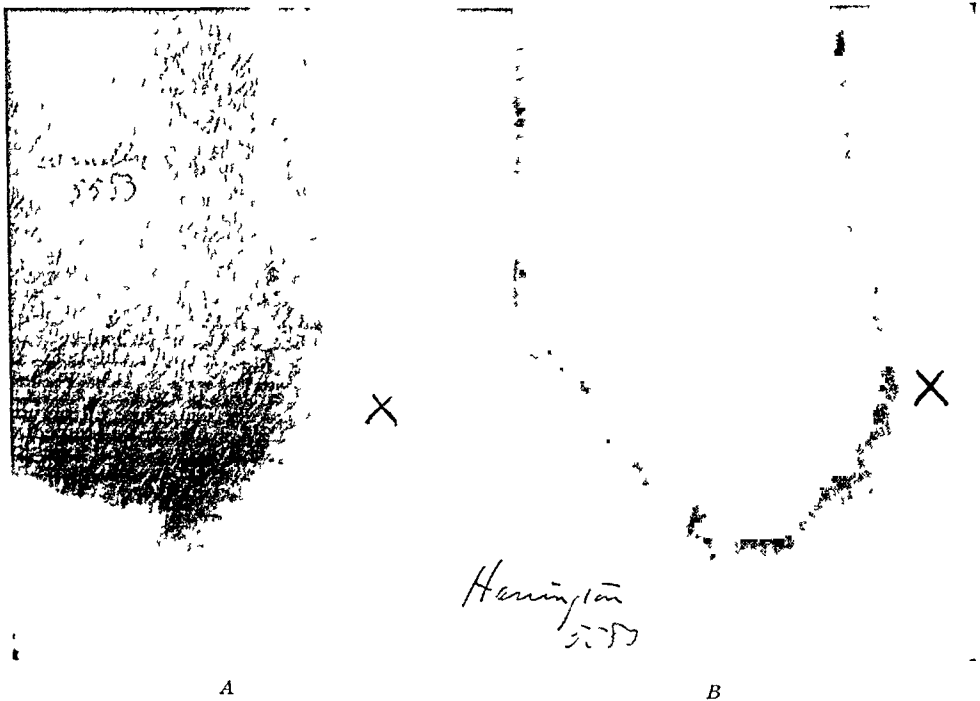


FIG. 4.—Drawings from a specimen of fresh fracture of the os calcis from the author's collection. This was originally a simple fracture of the os calcis of the ordinary type; a skin slough developed, with subsequent sepsis of bone, necessitating amputation. The upper sketch shows the bones as they appeared after maceration; some bone splinters were missing. The os calcis, as a whole, was much displaced upward and outward; the lower sketch shows a reconstruction of the bone, showing fracture-lines; there was irregular splintering in the region of the inner tuberosity, and a fracture-line running through the sustentaculum; the sketch to the left shows the os calcis from above, the last-named fracture-line appears, splitting the sustentaculum; another fracture-like branching from it entirely separates the back half of the sustentaculum; an irregular fracture-line separates the thick cortical plate of the outer side of the bone for a considerable distance. It is not believed that there is anything typical about this fracture-line, as will presently be shown; the X-rays seem to show all sorts of irregular, complicated lines of fracture. I believe, however, that the damage in this particular case is not more than in the cases we are in the habit of seeing.





FIG 5.—View of normal os calcis, seen looking down from behind—plate under the sole of the foot.  
X is the outer side



FIG, 6 —Like view of two old crippled cases of calcis fracture. Note the bulge in each cut, X, on the outer side, and, in B especially, the great total broadening of the heel bone.

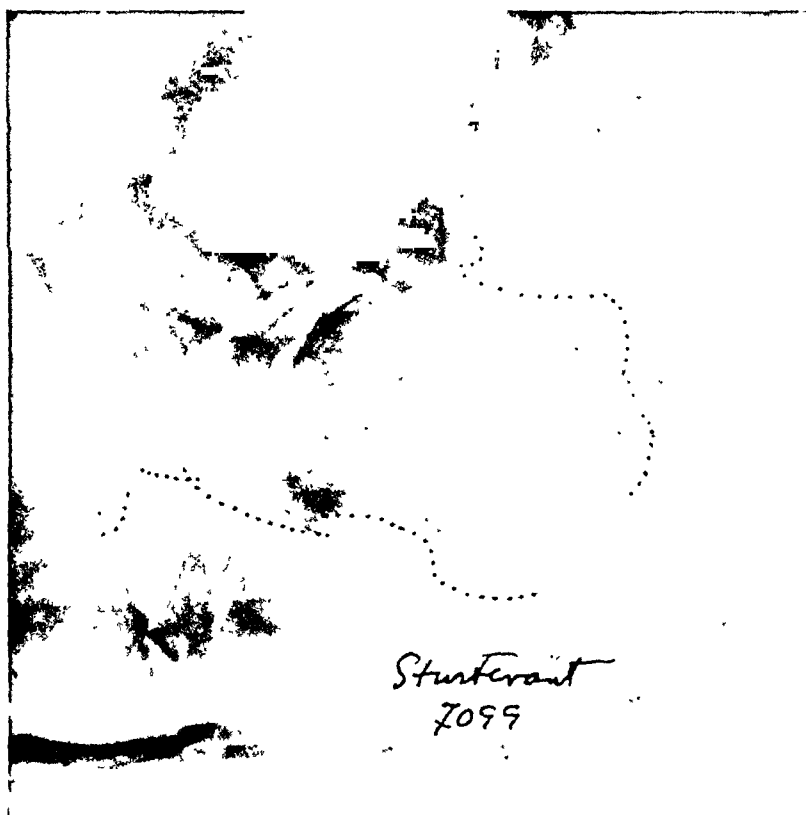


FIG. 7.—After reduction. A case with marked deformity at the start (X-rays taken lost). Shows, after reduction, both general bone outline and joint relations not far from normal. This man recovered nearly all his lateral motion and obtained an excellent result.

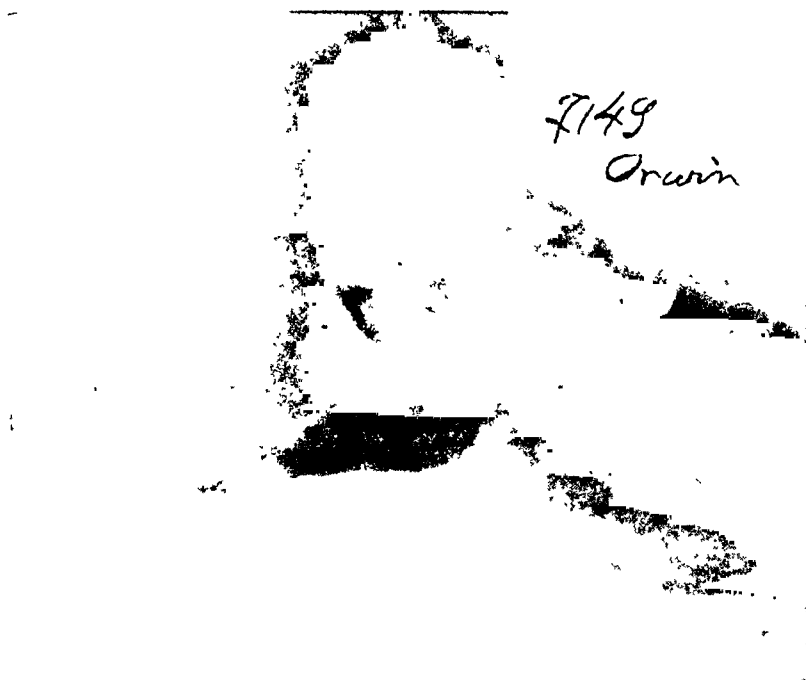


FIG. 8.—Recent case. Note decreased depth of bone at the front end, irregular spur formation beginning about the splinter that thrusts downward into the heel, and especially the distortion of the calcaneo-astragaloid joint from displacement along the fracture-line that runs into the front end of the joint. See Fig. 9.

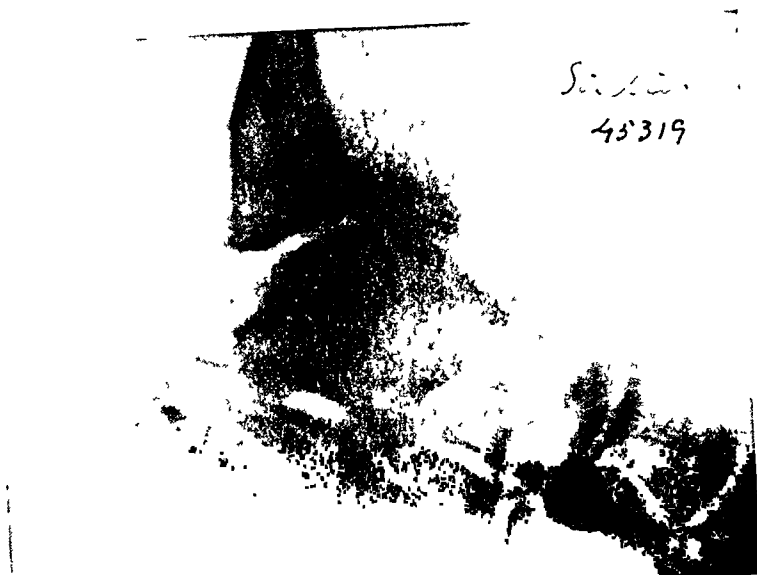


FIG. 9.—Distortion of same joint as Fig. 8, by displacement of fragments.

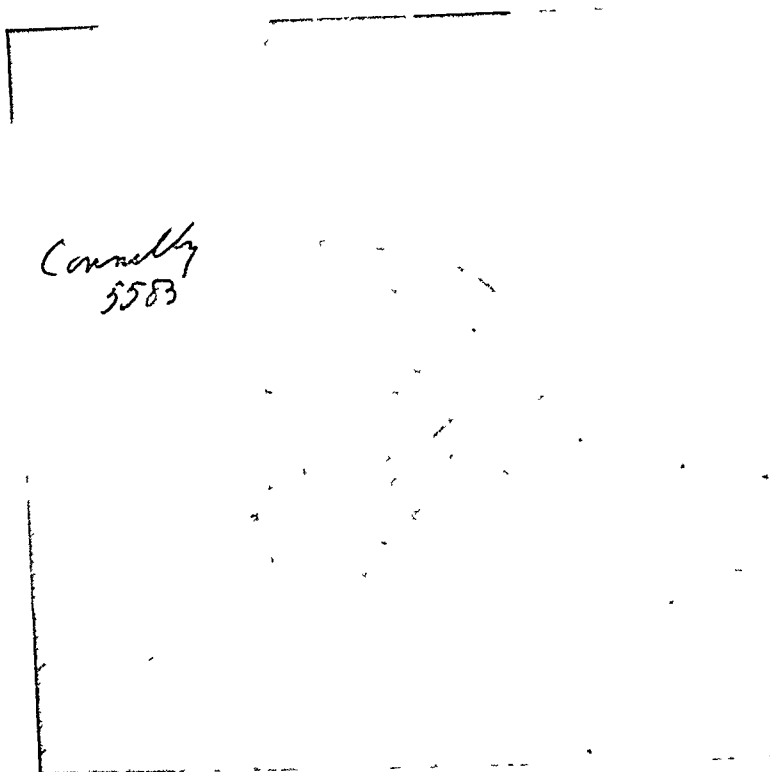


FIG. 10.—Old case. Note decreased vertical diameter of the forward end of the bone. Note also the fragment projecting into the sole, well forward (see Fig. 3). Also, note the posterior calcaneo-astragaloid joint, while perhaps not actually broken into, is so distorted as to be useless as a joint. In fact, this patient had no lateral mobility of the foot. Same case as Fig. 7, A.

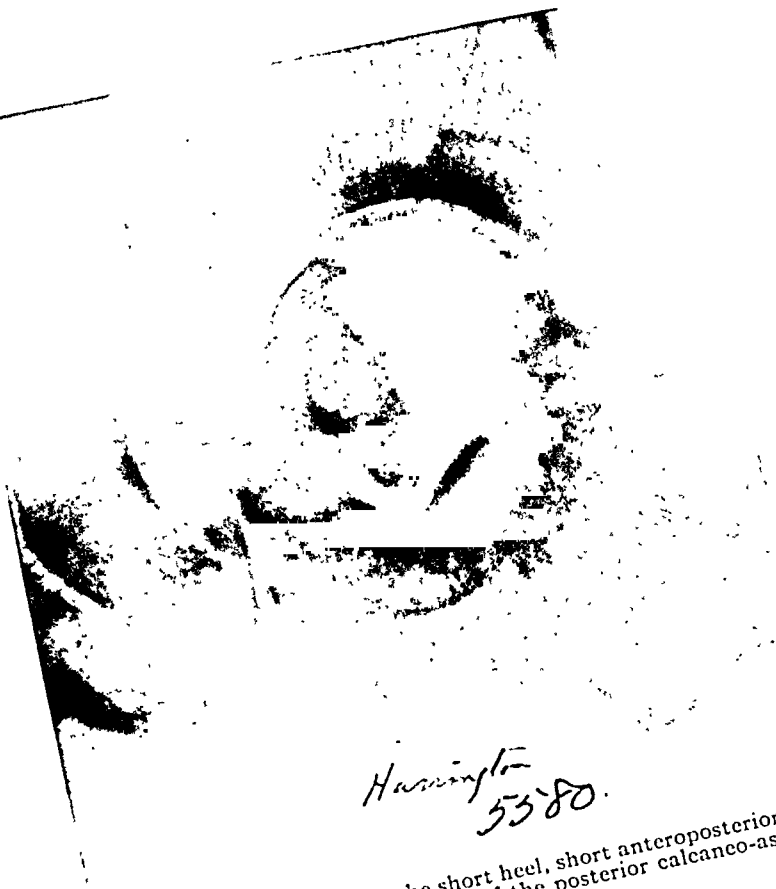


FIG. 11.—Old case, crippled. Note the short heel, short anteroposteriorly, and the shortening of the available joint surface on the calcis side of the posterior calcaneo-astragaloid joint.

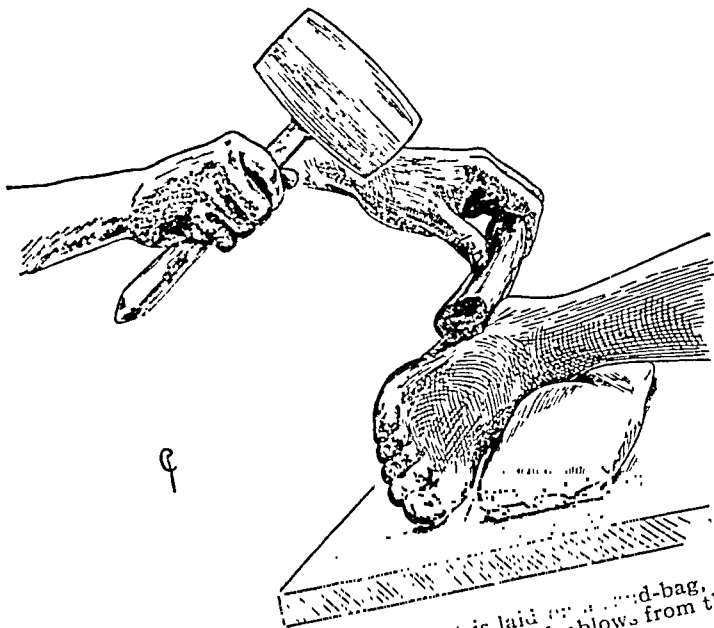


FIG. 12.—Treatment by impaction. The foot is laid on a sand-bag, a felt pad held to protect the outer side of the os calcis, which is then impacted by blow from the mallet. This impaction is used only after careful correction of position.

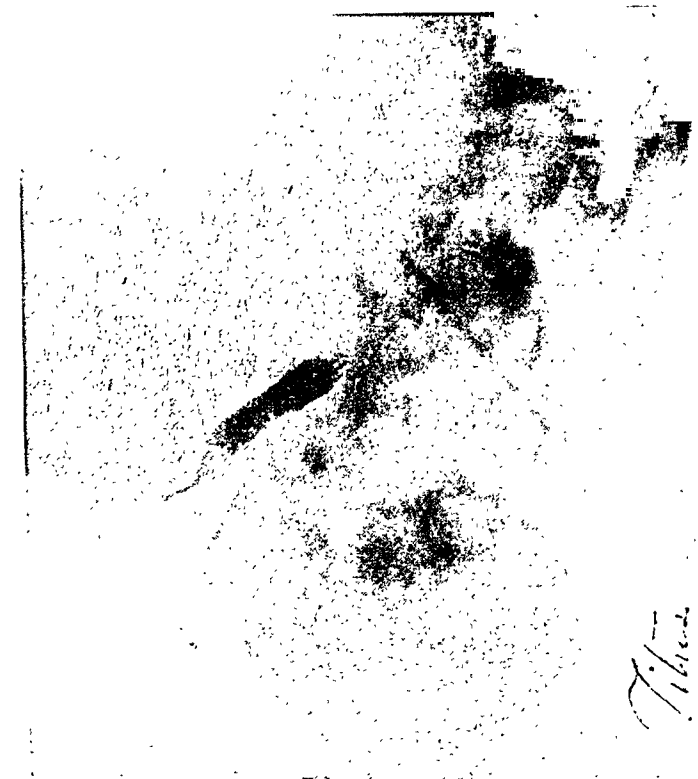


FIG. 13.—Before correction. Note the involvement of the posterior joint; also loss of vertical depth.

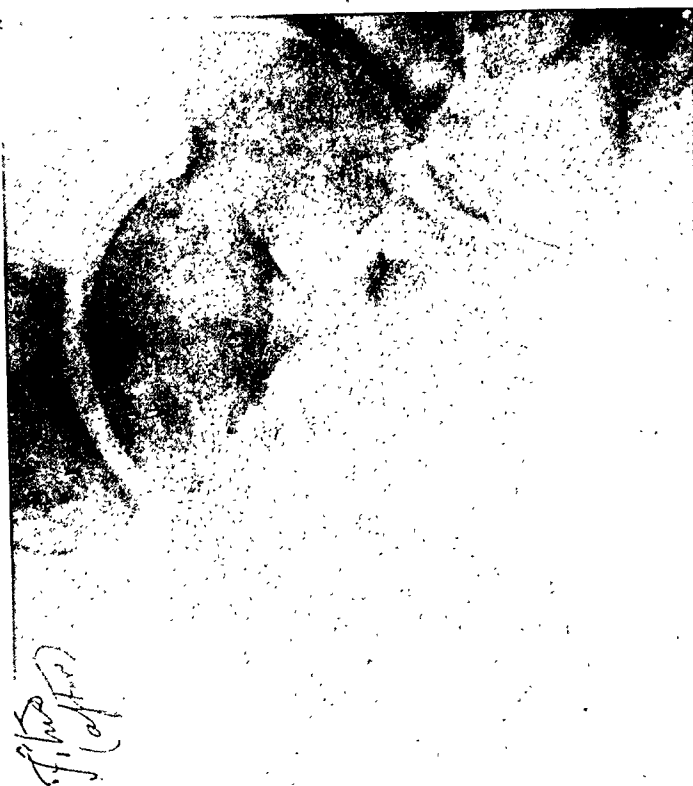
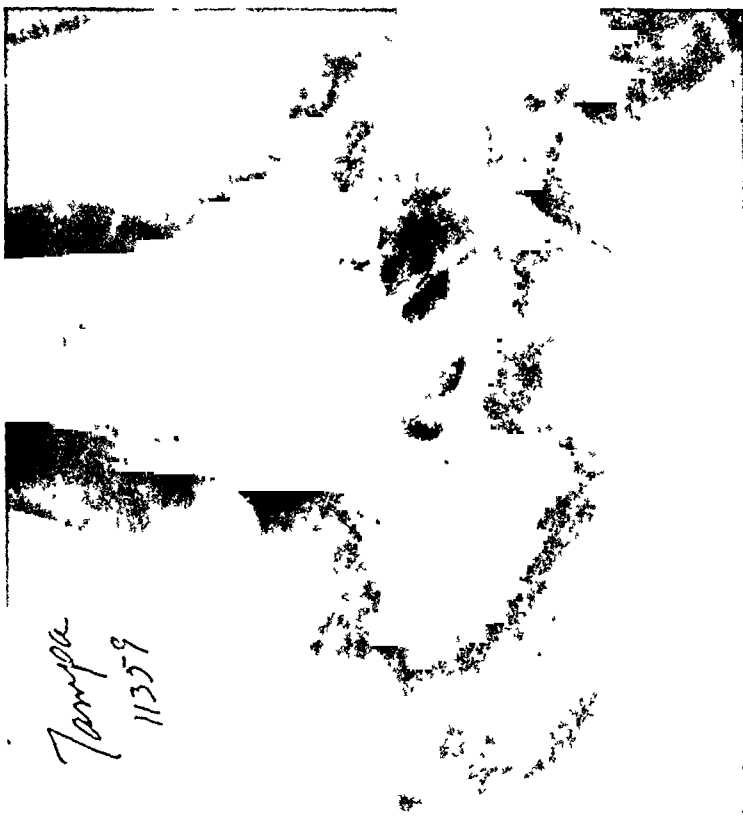


FIG. 14.—Same case as Fig. 13, after satisfactory correction and inpaction.

FIG. 15



FIG. 16



Figs 15 and 16 —Before and after reduction. Fig 15 shows not only deformity but joint distortion as well. Fig 16 (taken through the plaster and not clear) shows obvious improvement in both respects



## OS CALCIS FRACTURE

You will see that there are not only irregular fissures through the spongy bone (a number of them) but also a splitting away of a compact plate on the outer side, which is necessarily displaced outward in greater or less degree. This plate, more compact than most of the bone, carries on it the peroneal tubercle, so-called, and the peroneal tendon sheath, in which the tendons play about the pulley arrangement, of which the tubercle is a part. All this whole arrangement is pushed outward with, and in front of, the external plate of the bone. The plates here shown give an idea of this apparently constant displacement. (Figs. 5, 6 and 7).

So constant is this feature that I always expect it; have always, save in two cases, found unmistakable bony thickening at this point; have had no hesitation, when it was present, in making the diagnosis on this point alone, and have failed to confirm the diagnosis in but one out of many cases.

There is one other nearly constant factor—the interference with the joints between the astragalus and calcis; particularly with the posterior calcaneo-astragaloid joint. It may be directly involved, as in the dissected specimen (Fig. 4, and in Figs. 8, 9 and 13), or it may simply have its range of sliding motion shortened, or its alignment thrown out by the displacement of fragments, without the joint being broken open (Figs. 10 and 11).

In either case, it pretty surely goes out of commission more or less completely, as an effective mechanism. This is important, for R. W. Lovett and I showed long ago that it is almost purely between astragalus and calcis that the movements we call pronation and supination occur.

With the joints between os calcis and astragalus gone, pro- and supination disappears, and this is precisely what we nearly always find in os calcis fractures; lateral motion gone—up and down movement preserved.

These then are the features that are nearly constant: (*a*) Pushing up of the heel; (*b*) broadening of the bone, mainly outward; (*c*) interference with lateral mobility.

Now we all know that the usual treatment of os calcis fractures (even when not treated for sprain) is to put them up in plaster and trust to obtain the good results called for in all respectable text-books. What kind of results do we get? Wilson and I concluded in 1908, from a study of 22 cases found in an attempt to "round-up" 84 cases treated at the hospital, that at least half the cases (probably more) had some serious permanent disability; not always enough to prevent some work, but serious. I do not think that this statement is overdrawn. Latterly I have had referred to me, for late examination, 14 cases of os calcis



fracture, varying from eight weeks to two years after the fracture. They run as follows:

CASE I.—J. A., aged fifty-six; examined at 6 months; much thickening and tenderness; lateral motion lost; totally disabled.

CASE II.—M. J. C., aged sixty-four; examined at 3 months; refused reduction after accident; lateral thickening; tenderness on outer side; short heel; relatively little loss of motion; entirely disabled. Re-examined at 6½ months; better; slow and clumsy; totally disabled.

CASE III.—J. F. D., aged thirty-eight; examined at 5 months. As he stands, the external malleolus is in contact with the calcis; heel broad and flat; very little lateral motion; can walk a half hour, then has to quit; disabled.

CASE IV.—J. G., aged forty-four; examined at 17 months; typical deformity; not extreme; little lateral motion; disability mainly from contact of fibula with calcis; has tried plates, etc.; has much pain and disability. At 2 years 3 months after injury he reports that he is no better, despite exercises, etc.

CASE V.—C. H., aged forty-two; examined at 3½ months; typical deformity; not extreme; up and down motion normal; lateral motion fair; pain entirely on outer side; still disabled; may have some disability but promises a useful foot.

CASE VI.—J. T. L., aged forty-eight; examined at 3 months; much broadening; little displacement of the heel; lateral motions fair; now crippled but probably going to have a useful foot.

CASE VII.—G. J. J., middle aged; examination at 4 months; almost no displacement; disability mainly from the rare factor of spastic contracture of the peroneals; totally disabled but disability probably remediable.

CASE VIII.—H. L., aged thirty-seven; examined after two years; operated on for total disability at the Massachusetts General Hospital, where some bone was removed. Has loss of lateral motion; some thickening and much tenderness on outer side; totally disabled.

CASE IX.—D. M., aged twenty-five; examination at 9 months; fracture of os calcis, right and left. Shows usual deformity in both feet; loss of lateral motion in both feet; much thickening, externally, especially on the left. Can walk for half an hour only; it is very stiff and sore in the morning; still improving very slowly; good for nothing after nine months, and unlikely ever to go back to labor again, though he may improve.

CASE X.—B. C., aged thirty-eight; examined at 2½ months; broadening of heel, well marked; external thickening; up and down motions normal; lateral motions entirely gone. Re-examined

## OS CALCIS FRACTURE

at 3½ months; shows no return of motion; much pain at outer side on walking; entirely disabled; prospects certainly very poor.

CASE XI.—J. B., aged twenty-seven; examined at 2 months; treated as a sprain; great thickening on outer side; total displacement small; motions fair; gets about fairly well; promises to get a useful foot, but probably some trouble from the massive thickening under the external malleolus.

CASE XII.—J. J. S., aged thirty (about); examined after 13 months; thickening present, especially on outer side; up and down motion normal; lateral motion entirely gone; is wearing a plate; gets about with considerable discomfort and not handily; entirely disabled for active fire duty.

CASE XIII.—V. S., middle aged; examined after 10 months; typical deformity; also had a fracture above the ankle; well reduced and united; has tendo achillis contracture as well as total loss of lateral motion. A perfectly useless limb, but with the disability not entirely due to os calcis fracture.

CASE XIV.—C. W., aged twenty-six; examined at 4 months; type deformity; not extreme; considerable loss of lateral motion; up and down movements normal; total disability mainly due to pain on the outer side from contact of the fibula with the greatly thickened calcis. Later I cleared away much of the superfluous bone and stretched the foot into pro- and supination, with almost entire relief of symptoms.

Out of fourteen, none fit to work, when seen, and but three that looked at all promising. A pretty poor showing, when we remember that insurance companies nearly always call for examinations if a man is not on the job in two or three months; so these are probably pretty near an average run of cases.

Besides this series, Dr. Francis Henderson has been trying for months past to track down cases treated at the City Hospital within the last four years. Those of you who have followed the laborer in a big city, in his kaleidoscopic flittings and disappearances, will not be surprised at his indifferent success. Some cases have been found, however, as follows:

CASE XV.—L. B., aged fifty; examined at 3 months; was in hospital and had some manipulation; now shows limitation of all motions; lateral motion entirely lost; has a limp and much pain; is, as yet, entirely disabled.

CASE XVI.—G. P., aged forty-five; examined at 18 months; taken to hospital but would not remain. Shows general thickening about the heel, especially to outer side; lateral motions

entirely gone; up and down motion fair; gets about with an extreme limp and much pain; entirely disabled.

CASE XVII.—D. D. D., aged fifty-four; examined at 7 months; fracture never treated. Shows much limitation of flexion and extension; lateral motions entirely lost; all attempts at motion very painful; has not been able to walk at all on this foot since the accident; X-ray shows the type deformity.

CASE XVIII.—W. C. D., aged fifty-eight; examined  $2\frac{1}{2}$  years after; had had no reduction; unable to walk for 9 months; still has a bad limp; lateral motions gone; other motions poor; walks with a stick; practically crippled.

CASE XIX.—A. J., aged thirty-eight; examined after 20 months; much deformity of the heel; arch gone; all motions practically gone; walks with a limp, using a stick; disabled.

CASE XX.—A. D., aged fifty-four; examined after  $2\frac{1}{2}$  years; original X-ray shows not very severe displacement. After  $2\frac{1}{2}$  years he still limps; shows a great deal of thickening under the external malleolus with some tenderness there; up and down motion fair; lateral motion entirely gone; a good deal of pain; has serious disability but manages to work as a painter.

CASE XXI.—J. M., aged eighteen; examined 2 years after accident; was on crutches 9 months; since then he has walked with a limp and has a great deal of pain in the morning; shows general thickening; lateral motions entirely lost; up and down motion not good; works as a painter despite his disability.

The foregoing cases were untreated or treated only by manipulation and plaster. Those that follow had some real attempt made to correct conditions. The City Hospital staff have been taking os calcis cases seriously enough of late to do something, or have the house surgeon do something.

CASE XXII.—J. J. H., aged forty-four; examined 3 years later; was unable to walk for 8 months; now walks with a limp; there is much thickening under the external malleolus; up and down motions good; lateral motions gone; complains of much pain; unable to stand for any time; completely disabled. (This case had only a hammer impaction done.)

CASE XXIII.—J. R., aged thirty-five; examined 2 years after; had hammer impaction done under ether; began to walk at 15 weeks; has marked restriction of lateral motion; has a very slight limp; is working as engine house fireman; disability slight.

CASE XXIV.—J. R., aged thirty-nine; examined after 2 years and 10 months; had some sort of reduction done and comparison of original X-rays before and after shows marked improvement.

## OS CALCIS FRACTURE

Shows much restriction of lateral motion; up and down motion fair; shows a good deal of thickening; has a considerable limp but works as striker on a coal team; disability slight.

CASE XXV.—D. M. G., aged fifty; examined after three years; "reduction under ether"; noted as having shown a marked flattening; went to work after 13 months; did some work for a year; shows broadening and thickening; lateral motion gone; up and down motion poor; has to use a stick to walk any distance; entirely disabled. (No impaction done in this case.)

CASE XXVI.—S. S., aged twenty-four; examined after three years; said to have been "partially reduced"; shows only moderate thickening but lateral motions are gone; flexion and extension perfect; has a good deal of pain and lameness in the morning; works as a sign painter; disability not great.

CASE XXVII.—M. S., aged forty; examined after two years; was reduced by the house surgeon after my method; original X-ray shows much crushing; has a great deal of thickening; a good deal of loss of lateral motion; limps and says he has a great deal of pain when he has been on his feet all day; disability considerable.

CASE XXVIII.—J. R., aged forty; examined  $2\frac{1}{2}$  years later; reduced according to my method; returned to work in 11 weeks as a carpenter but had trouble for 6 months. Now shows all motions practically perfect; no considerable deformity; walks well and has no pain; at work; perfect result. (Original X-ray shows displacement not extreme; joint not involved.)

CASE XXIX.—D. H.; double fracture; reduced my way; six weeks later getting around pretty well. Investigation  $2\frac{1}{2}$  years later found he had died. (Immediate result of reduction good.)

CASE XXX.—G. M., aged fifty-six; examined 3 years later; was reduced by my method; noted as a case with much thickening externally; lame for 7 months. Now shows slight thickening; a little limitation of lateral motion; has no pain; is back at work in Navy Yard; perfect result.

With these should go private cases:

CASE XXXI.—A man of forty-five for whom I did an impaction last winter, who has now a practically perfect foot.

CASE XXXII.—A friend of mine, a doctor, on whom I did the first impaction, with a perfect foot.

CASE XXXIII.—A case seen for Dr. Emil Geist last year, in which, despite obvious deformity, everlasting massage and exercises brought about very good function.

There is no time here to speak of results of operative treatment on these cases; late intervention, mine or others'. Such operations would rarely be necessary were the cases properly treated at the start.

Now, imperfect as the series is, it covers an end-result investigation of 55 cases, out of original lists of 153; reduced for error to 144 cases, with real data on 55.

Now it is perfectly evident, from the cases cited, that

First, results without more treatment than the traditional plaster are appallingly bad.

Second, with some pains taken (some attempt at reduction) the results are better; sometimes even excellent.

Therefore, we should try to do something: reduce wholly if we can; partly at worst.

My method—or really the method the late Louis Wilson and I worked out together—is as follows:

(1) Loosen up the fracture by manipulation.

(2) Pull the heel down. We used to put a sound through from side to in front of the heel-cord, and pull down; latterly I use ice-tongs as easier to handle and affording a better grip.

(3) Free the joint motion between astragalus and calcis.

(4) Push in the displaced bone under the external malleolus; this narrows and shapes the whole bone. We do it by slowly striking with a big mallet on the outer side of the foot; padding with felt to take the blow; supporting the inner side of the foot on a sand-bag. This impacts, and, owing to the fact that the outer plate is firm, the impaction is usually fairly solid.

(5) We put the foot up in plaster; not at a right angle but with the heel-cord slack; also we avoid direct pressure on the heel.

It is well after the impaction to test again as to the presence of lateral motion. If the impaction has impaired it, work the joints loose again and re-impact. This is rarely needed, however.

I have done this impaction many times; have never failed to get improved position and have usually succeeded in entirely abolishing the abnormal prominence below the external malleolus, and in restoring the lateral motion and in getting a serviceable impaction. Bringing the heel down where it belongs does not always work out so well, but is less important (Figs. 14-16).

Handicapped by poor records and the extreme difficulty in tracing the shifting artisans of big cities, I can give you no real presentation of end-results achieved, though I hope to later on.

What I would say now is that os calcis results are too bad to put up with, as they run, and that the method of treatment presented is, so far as I know, the only proposal that is even logical.

It is logical; it is feasible; it seems to work and I think it deserves further trial.

# TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY

*Stated Meeting, held May 8, 1916*

The President, DR. CHARLES H. FRAZIER, in the Chair

## EXOPHTHALMIC GOITRE

DR. ALBERT J. OCHSNER, of Chicago, read by invitation a paper with the above title, for which see page 385.

## THE SURGICAL TREATMENT OF GOITRE

DR. MILES F. PORTER, of Fort Wayne, Ind., read by invitation a paper with the above title, for which see page 395.

DR. GRANVILLE T. MATLACK, of Wilkes-Barre, said that in relation to the treatment of exophthalmic goitre it should be kept in mind that this disease is one in which distinct remissions may be expected, irrespective of treatment. This remission in some cases is very marked and lasts many times for several weeks. The patient may express herself as being well, put on weight, and gain in strength, and then the symptoms recur. If any form of treatment was being used at this time, it would naturally get the credit for the improvement.

The mortality records following operations for exophthalmic goitre have improved not because the operation has become any easier to perform, but because more consideration is given to what the patient can have done with reasonable safety; when to do it, how much to do, and the proper care before and after operation.

Preliminary ligation, either one or more poles, is regularly done in the acute, severe exophthalmic goitres with chronic and secondary symptoms, cardiac dilatation and loss in weight. The ones that are bad mentally, and those whose sleep is more or less disturbed, are certainly cases for ligation. Marked improvement is shown by this operation, and a safe thyroidectomy can be done in from two to four months, depending on the condition of the patient. These cases, however, will invariably relapse to their former condition if a thyroidectomy is not done. It is well to impress upon the patient and the patient's caretaker the importance of the thyroidectomy after ligation, as the

patient may consider herself well afterward, and you may not hear from her until she has developed a state that is decidedly worse than when the ligation was performed.

Regarding the operative cures, cases are seen which come late for operation with secondary effects in the heart and kidneys. In these cases, of course, one would not expect to get a permanent cure, because the damage was done before the gland was removed. In some cases in which there has been resection of both lobes, in a few months or a year or two the gland will seem to replace itself, and these patients will have a return of symptoms and a second operation is necessary. Many times, clinically, in the non-hyperplastic thyroids, there will occur an almost exact exophthalmic goitre syndrome. The surgeon will think he is dealing with a regular type of exophthalmic goitre, and the difference between these two types of goitre, clinically, is sometimes very hard to tell. A late case is a dangerous case of goitre, and one not improved by ligation of the superior poles. These patients are improved simply by rest in bed and some medical treatment, such as digitalis. This prepares them for a thyroidectomy. They will not bear ether very well and it is better to operate under local anæsthesia. In his own work he gives ether in nearly all exophthalmic goitre cases with one-tenth per cent. novocaine, with ten minims of adrenalin to the ounce. In five years, from 1907 to 1911 inclusive, he had done 119 thyroidectomies for exophthalmic goitre, with two deaths. Eighty-two of these patients have made a permanent recovery. Twenty of these 119 cases received preliminary ligation; one died following operation; two of the cases have recovered simply by ligation.

DR. JOHN B. DEEVER stated that he believed that the majority of exophthalmic goitres originate in a simple goitre. Therefore, the simple goitres are not medical cases, should not see the medical man, but should be referred at once to the surgeon. This has been his teaching for the last few years, also that an exophthalmic goitre seen early should be operated upon immediately. He appreciated the statement that a certain percentage of these cases will get well or be greatly improved, but he believed a much larger percentage will come to operation or will die of toxæmia consequent upon that goitre. Therefore, the question goes back to the original proposition that it is a great deal better to subject the patient to operation in the incipency of the disease. He had never lost a case of exophthalmic goitre when the conditions were at all favorable for operation. He had, like other men, lost cases in which there was a degenerated heart, whether it was due to myocarditis, advanced nephritis, or what not. A certain percentage will

die. If these cases could be seen early they probably would get well. From his experience in following up cases, he said that after early operation many get well and stay well. In the late cases or cases pretty well advanced, although about 50 per cent. do not come to secondary operation, they are not greatly benefited by the original operation.

In the question of boiled water treatment he had had but one experience. The patient was treated at the German Hospital; one of his assistants carried out the treatment and in fifteen minutes the patient was dead.

DR. JOHN D. McLEAN said that in his experience in Philadelphia very few goitres are seen by the medical man. He related, however, a case which he had been watching for seventeen years. The first intimation he had that the patient had exophthalmic goitre was when she developed an extensive and obstinate lupus erythematosus of both eyelids, extending from the temples and back to the ears. The patient had received almost every form of treatment without benefit. The condition was left alone for about two months when it disappeared entirely. Shortly after that the eyeballs began to get a little prominent and the thyroid to enlarge. During the course of this disease the patient developed an abscess of the right kidney which was operated upon with recovery. The greatest improvement in her condition was due to morphine, which was used because she could not sleep. The pulse was so rapid it could not be counted. About two years ago she was sent away from the city to an institution where she was kept at absolute rest of both mind and body for three months, and since then the improvement has been permanent. The gland is almost normal in size, the exophthalmos just the same as at the beginning of the disease. She is in excellent health with the exception that at the slightest exertion her heart becomes very rapid. Concerning treatment he was of the opinion that nothing will do more good than absolute rest of mind and body.

DR. CHARLES H. FRAZIER said that the incidence of goitre on the Atlantic seaboard is insignificant compared with that in the goitre zone farther west. However that may be with regard to simple goitre, there is no doubt that toxic goitre is much more prevalent in the East than it used to be, so that in the eastern clinics we are being confronted with an increasingly large number of such cases. Emphasis should be placed upon the pathology of toxic goitre, because a clear understanding of the pathology is absolutely fundamental to the intelligent management of the disease. In his own clinics he had adopted the classification of Plummer: (1) The non-toxic non-hyperplastic; (2) the toxic



non-hyperplastic, and (3) the toxic hyperplastic or typical exophthalmic goitre.

Attention has been drawn recently to the clinical syndrome of toxic goitre with gastric disturbance. Diarrhoea is frequently observed as a symptom of toxic goitre, but his attention had never been called, until recently, to gastric disorders, and he was rather surprised to learn from the writings of Ewart that he regarded gastric dilatation with gastric disturbance as more or less fundamental to the clinical syndrome of toxic goitre. He said it was the rule rather than the exception.

Another point with which he had been impressed in his rather limited experience was the relationship of tonsillitis to the etiology of toxic goitre. More emphasis should be placed upon this definite relationship in the pathogenesis of the disease. He had been struck by the frequency with which the tonsils have been diseased in his toxic goitre cases. He had seen many cases in which the signs of toxicity followed closely upon attacks of acute tonsillitis, and what is still more convincing, he had seen marked improvement follow the removal of tonsils in such cases. So that now he advocates, where the tonsils are diseased, a tonsillectomy preliminary to ligation or lobectomy. Although his own experience does not include any cases in which either the X-ray or the operation revealed enlargement of the thymus gland, quite a large number of cases are on record now, where there is an associated enlargement of the thymus gland. The exacerbation of the disease in these cases has been attributed to the thymus involvement and the removal of the thymus was followed by very striking relief. Von Haberer gives the records of two or three cases, in which operation upon the thyroid gland itself had failed, and the partial removal of an enlarged thymus gland was followed by striking and immediate relief. It has been recommended that routinely the thymus gland, if found enlarged at the time of operation, be removed. He doubted very much the advisability of this, as it would undoubtedly increase the mortality, and the part which the thymus gland plays in the pathogenesis of the disease is not sufficiently constant.

One of the most important factors is the selection of the time and the character of operation. He was entirely in accord with what the previous speakers had said regarding the avoidance of operating during the acute exacerbation of the disease. He never, at the first visit, gave an opinion as to whether operation was required, of what character it should be, or when it should be performed. This opinion is always reserved, no matter how insistent the attending physician may be that operation be done without delay, or how much better he thinks he

understands the patient's peculiarities, until the patient has been under observation at least one, and sometimes two, weeks, usually in the hospital, and always in bed. When in doubt always err on the side of conservatism; boiling water injection is safer than a single ligation, a single than a double ligation, a double ligation than a lobectomy. Upon the theory that in ligation of the superior pole the nerve supply is included, superior pole ligation should be given preference to ligation of the inferior pole. There is no doubt that the functional activity of the gland responds very positively to nerve stimulus, and, if we ligate the entire substance of the superior pole, including the nerves as well as the vessels, we accomplish more than by ligation of the vessels alone. The secondary operation of lobectomy is very much easier to perform if the superior poles are exposed through independent incisions one-half inch below the upper margin of the thyroid cartilage.

It is a curious fact that there is no consensus of opinion upon the selection of an anæsthetic. Looking the world over we see in three large clinics Kocher using local anæsthesia, Ochsner using ether, and Crile, nitrous oxide. As each anæsthetic is advocated in equally strong terms the choice must be left to one's own judgment and experience. A strong argument can be made for general narcosis as against local anæsthesia, in all forms of toxic goitre, and an equally strong argument for nitrous oxide as against ether. He believed absolutely in the application of the general principles of anoci-association.

Except in one or two cases he had not employed boiling water injections, so that he could not speak of this procedure from personal experience. In very severe cases the mortality may be as high perhaps as in ligation. Statistics from the Mayo Clinic give two deaths from ligation and two from the boiling water injection. This is not offered as a criticism against the latter treatment, but merely to show that no matter which method is used in the very severe cases, there are bound to be fatalities.

The expectation of life in the natural history of goitre is an important question as applied to the indication for surgical therapy. In the untreated cases the tendency in the gland to undergo a process of retrograde metamorphosis, and for the condition to be transformed from one of hyperthyroidism into one of hypothyroidism, is not to be lost sight of. The possible sequence of events is one of the strongest arguments in favor of early operation, since in the terminal stages the prognosis is invariably grave and surgical intervention futile.

DR. OCHSNER, in closing, remarked that as to tonsillar infection in goitre of adolescence, he believed that at least 75 per cent. of the

cases that he had seen became permanently well by removal of the infected tonsils, by drinking boiled water and following a sensible diet and hygiene, and by getting 8 to 10 hours of sleep with open windows. In certain places in Michigan and Illinois there were goitre wells. Farmers whose children were free from goitre when living in a certain section found that they began to develop goitres upon moving to another farm. In these cases no further goitres develop if all drinking water is boiled. He referred to experience quoted by Dr. Bircher. Seventy per cent. of the entire population of Rapperswyl in Switzerland had goitres so long as they used the water from alluvial soil on one side of the valley, but when the water was used from the granite rocks from the other side of the valley, the goitres disappeared from the children in the village. The same conditions were noted in two young ladies' seminaries situated a mile and a half apart.

Hyperthyroidism seems to affect certain muscle groups. A patient coming into one's office may suddenly, when she sits down, drop her weight into the chair. Perhaps a woman brings her daughter, and says she constantly drops the dishes or anything she attempts to carry; that when she goes upstairs her heart beats rapidly, and her legs refuse to carry her. He had seen cases sent to the hospital for operation for dilatation of the stomach in which the stomach muscles were affected and the stomach relaxed because of hyperthyroidism and in which tremor and tachycardia were present, in which no attention had been paid to the thyroid gland.

He had not been able to make out the enlarged thymus gland as an accompaniment of hyperthyroidism. He had not been able to outline a thymus gland in his thyroid cases, although the X-ray plates have shown frequently that the hyperthyroidism is accompanied with enlargement of the thymus gland.

X-ray treatment seems to increase the general hyperæmia and he had had a lot of cases upon which he had operated who had previously received X-ray treatment for a while. Several years ago C. H. Mayo wrote a paper on "X-ray in Hyperthyroidism," and he used the treatment in a series of cases at that time. He thought at first that it might improve the condition of these patients, but he could see no permanent benefit. It is so very easy to imagine that this or that form of treatment helps a case of hyperthyroidism. In this connection he had a very peculiar experience. A friend of his whom he had known for many years and who had practised in Colorado, found that goats that were infected with a certain parasite had goitres, and that if they were dipped the goitres disappeared. Also if some form of mercury was

## THE SURGICAL TREATMENT OF GOITRE

administered the goitres disappeared. He thought that the same remedy would cure exophthalmic goitres in man and tried it upon all the cases he could get. There were at that time two patients in the hospital nearly dead with hyperthyroidism. In one of these Dr. Ochsner tried the remedy, while the other one was so seriously ill that he did not dare to risk the use of any remedy, and in three weeks both were so much improved that he was justified in removing the gland and they both got well. He had a patient who came from Michigan with bad hyperthyroidism whom he intended to treat in the same way, but as he was going out of the city for a time and had not the remedy at hand, he simply gave her a diet list and general directions for rest and hygiene, and in three weeks when he returned, the goitre was almost well. She had come from a goitre-well region. He had had any number of similar experiences. In one case a woman came from Mexico, Mo., who had consulted a physician in St. Louis, who advised her to use a certain kind of pad said to cure goitres. When she returned to learn how to apply the pad a few weeks later, the condition had improved remarkably and this improvement was at once credited to the action of the pad by the medical man, when in reality the pad had not been worn at all. Under almost any quieting treatment these cases will improve to a certain point where it is safe to operate. He had been so convinced of this that during 1915 he operated upon 106 cases and used this plan throughout, with but one death. The fatal case was a big strapping fellow from the South, who seemed in such good general condition that he felt he could operate at once, notwithstanding rather marked hyperthyroidism. The year before he had operated upon a daughter of this man who was in a fearful condition, keeping her quiet for ten days prior to operation. This man was one of the stubborn sort who would not keep still; he would jump up and exert himself unreasonably, and in one of his jumps he had an acute dilatation of the heart and died. Had he kept him still for a few days before the operation, he would probably have lived through the operation. Of 561 cases operated during six years previously, he had lost 16 cases, so that the death-rate was three times as high before he carried out this plan absolutely.

No doubt local anæsthesia is the best if one can treat his patients as Kocher does. When he talks to them they hold still, no matter what happens. If one can do that, it works. Recently he had one of these patients. When the patient was brought up the anæsthetist said, "I don't think we had better risk that case." The pulse was 160 and went to 170 and 180. Dr. Ochsner went out and spoke to her about local

anæsthesia and she said, "Anything you say is all right." He knew that in that frame of mind taking out the thyroid would not do her any harm. He used novocaine and she sat up the same afternoon and was out of bed the next day.

Regarding gastric lavage after thyroidectomy, it should not be forgotten that if the stomach is washed out with water at 100° F., the patient will be very much less likely to suffer from post-operative hyperthyroidism.

DR. PORTER, in closing, said that in the vast majority of the so-called simple goitre cases later hyperthyroidism develops and in the end myxœdema. All of the myxœdema cases at one time or other were cases of hyperthyroidism, so-called. If they live through they will become myxœdemic. That is the reason they become fat.

He would emphasize the point made by Dr. Deaver that the majority of cases of exophthalmic goitre were once simple goitres. It corresponds with what we know of the history of goitre checked up with the microscope. It is true that an occasional case of so-called exophthalmic goitre is met with without a palpable goitre. While this is possible, it is very rare.

He had never seen a malignant thyroid which was not engrafted upon a simple thyroid. If that be true, and it be true that exophthalmic and toxic goitres were once simple goitres, surgeons are abundantly warranted in saying that every simple goitre should come out.

Regarding the end results in thyroidectomy, he was not unmindful of the fact that the thyroid is a protective agent perhaps against all sorts of infection and intoxication; but, if by thyroidectomy one happens to make a little too extensive removal of the thyroid, one has not done anything more than Nature will do if the individual lives long enough. Ultimately the thyroid will undergo cytolysis; all the cells will be broken down and the individual will be in the position of the myxœdemic patient.

One word about the injection of boiling water. *Per se* the treatment is without risk. A certain per cent. of these patients will die in spite of any treatment. The mortality that follows the boiling water injections is the result of the disease rather than the treatment. That the boiling water treatment is a life-saving procedure in properly selected cases has been proven. It has been said that the way to cure hyperthyroidism is to take out the thyroid. This should be the treatment of choice when it can be done without risk.

# TRANSACTIONS

OF THE

## NEW YORK SURGICAL SOCIETY

*Stated Meeting, held April 12, 1916*

The President, DR. CHARLES N. DOWD, in the Chair

### FOREIGN BODY IN THE ŒSOPHAGUS

DR. GREEN presented a man twenty-two years old who, on February 5, 1916, while asleep, swallowed a hard rubber dental plate with three teeth. He was admitted to the Surgical Service of St. Luke's Hospital the same day and was X-rayed by Dr. Le Wald. A very clear röntgenogram showed the outline of the plate with the three teeth downward lodged in the upper part of the œsophagus. Without delay, under cocaine and adrenalin anæsthesia and with the aid of a short œsophagoscope, the foreign body was located. It was grasped with forceps through the œsophagoscope and removed together with the instrument. He was advised to remain in the hospital the following day in case of reaction from any possible laceration, and was discharged at the end of that time with no further discomfort.

### ABSCESS OF LUNG

DR. BENJAMIN T. TILTON presented a man, thirty-seven years old, who five years ago had an attack of acute lobar pneumonia on the left side, and was sick in bed two weeks. After this he had winter cough every year, and was never in as good health as before the pneumonia. Last summer he complained of pain in the right side of his chest, had a cough and expectoration and was losing weight. His sputum was repeatedly examined at this time and reported negative for tubercle bacilli. He gradually became weaker, expectoration increased and, when admitted to the hospital on October 31st last, gave the appearance of a patient with pulmonary tuberculosis. He was much emaciated, with flatness over the entire lower part of right chest and absence of breathing sounds. A needle inserted two inches found pus. The sputum was abundant, purulent and foul-smelling. The X-ray picture was not satisfactory.

A diagnosis was made of abscess of the lung involving the lower lobe. On account of the long duration and the history of previous pleuritic pain, it seemed probable that the visceral and parietal pleuræ were adherent and there would be no danger of pneumothorax from

opening the chest. His temperature was 99 to 100, pulse 126, and respiration 26.

On November 1st, the ninth rib was resected under novocaine owing to the fear of employing a general anæsthetic. A large amount of pus was evacuated and the finger explored a large cavity in the lower lobe. Two drainage tubes were inserted. The patient was kept in the open air during the next weeks. The expectoration of pus stopped almost immediately and the general condition improved very gradually. He was discharged on December 15th, six weeks after the operation, with a sinus still open.

No organism could be isolated from the pus taken from the chest. Three days after admission the sputum was positive for tubercle bacilli, and also a month later.

At the present time, five and a half months after the operation, the patient has gained 40 pounds, has no cough or expectoration and the sinus has been closed three weeks.

The X-ray plate taken a few days ago shows a marked infiltration at the base of the right lung due to healing of the abscess.

The case seems worthy of report in view of the successful result in spite of the long duration of the abscess. As is well known, chronic abscesses do not give favorable results from operative treatment on account of the indurated condition of the adjacent lung tissue preventing a collapse of the abscess wall. The prompt healing of the fistula and the lung and the marked gain of weight and disappearance of all pulmonary symptoms would seem to point against a tubercle etiology.

#### HEMORRHAGE AFTER GASTRO-ENTEROSTOMY: RECOVERY AFTER TRANSFUSION.

DR. TILTON presented a man forty-two years old, who had had stomach trouble for five years. This began with fulness after meals, belching of gas, pyrosis and nausea which came about an hour after meals. These symptoms occurred intermittently for three years. Two years ago he began to have severe pain in the epigastrium about an hour after meals and also a gnawing pain at night. The pain was relieved by taking food. For the past few months has been vomiting considerably and sometimes food that he had eaten the day before. He had lost twenty pounds in weight.

The X-ray findings were reported by Dr. Hirsch to be those of chronic duodenal ulcer with thickening and obstruction at the pylorus, enlargement of the stomach, atony and hypersecretion.

*The Stomach Analysis.*—One hour after a test meal of a roll and

## HEMORRHAGE AFTER GASTRO-ENTEROSTOMY

250 c.c. of water, 375 c.c. was obtained of a strongly acid odor. Free HCl 54; total acidity 88; no lactic acid; no blood; microscopically undigested food particles, mucus and shreds.

Operation performed March 18th, revealed a markedly dilated stomach, a mass at the pylorus about the size of a mandarin, non-adherent and without glandular enlargements. A posterior no-loop gastro-enterostomy was done as quickly as possible. The patient was in no condition for pylorotomy, which is the operation of choice in these cases even though the pyloric mass is benign in appearance. The patient did not vomit once after the operation and his condition was in every way satisfactory until the fourth day, when blood appeared in the stools and the pulse went from 80 to 120. During the next two days the blood continued in the stools, but there was no vomiting. The hæmoglobin gradually went down to 20 and the pulse reached 140. A marked apathetic state of mind gradually supervened and it was evident that something radical would have to be done.

Injections of horse serum had had no effect upon the bleeding. A transfusion seemed indicated and was performed by Dr. Unger by his own method on March 24th, six days after the gastro-enterostomy. Five hundred c.c. of blood were transfused and the immediate effect was marvellous. The depressed mental state cleared up immediately, the hæmoglobin rose to 30, the pulse dropped to 110 and a few days later to normal. The hæmoglobin in fourteen days was 80 per cent. There was no recurrence of blood in the stools.

The patient is leaving the hospital to-day and for the past week has been on regular diet. This seems to be a benign stricture of the pylorus but it is uncertain whether there may not be germs of malignancy in the chronic ulcers which will be heard from later. The transfusion certainly saved his life from slow hemorrhage.

DR. W. A. DOWNES asked Dr. Tilton what he considered the source of hemorrhage and the type of suture he used in the case reported. He asked this question because last year he had a very severe hemorrhage following gastro-enterostomy, coming on in twelve hours, with such severity that immediate re-operation was required. This patient lost considerably more than a quart of blood and was in collapse. The gastro-enterostomy was made with a continuous self-inverting stitch, but the larger vessels were not ligated separately as should be done. Upon re-opening the case through a gastrostomy, free bleeding was apparent along the margin of the stoma. This was controlled by continuous catgut suture and the patient recovered.

Dr. Downes does not think it is correct to assume that all cases of hemorrhage following gastro-enterostomy will stop spontaneously,



but that treatment must be decided according to the symptoms in each case.

DR. F. TOREK said that the important thing to prevent hemorrhage is to tie all the vessels, not to depend on the suture. Apparently this particular precaution is not attended to by a great many in doing gastro-enterostomy. The excuse perhaps lies in the fact that while the stomach and the intestine are clamped no bleeding is seen. Since he had adopted the plan of tying every visible vessel in the incision of the stomach, he had never had a hemorrhage.

DR. TILTON added that at the last meeting Dr. Woolsey reported a case of gastro-enterostomy with hemorrhage on the ninth day, which persisted in spite of horse serum and transfusion. He did gastros-tomy, and found that there were no signs of an active bleeding at all. To make sure, he passed a suture around the anastomotic opening. The second operation in this case was perhaps unnecessary and could have been avoided by a second transfusion.

A transfusion should always be tried before opening the abdomen a second time. Its value in stopping the hemorrhage from gastric and duodenal ulcers is unquestionable. He had had two other cases of serious hemorrhage after gastro-enterostomy. The hemorrhage came on in both cases within the first twenty-four hours, and the patients were both exsanguinated, but recovered without secondary operation.

From observing these three cases he had concluded that a secondary laparotomy is very seldom necessary in these cases. Certainly the two cases just spoken of were very alarming cases of hemorrhage. But these cases will usually take care of themselves. The hemorrhage will stop just as soon as the arterial pressure goes down. Secondary opening of the abdomen under these conditions is an operation of considerable magnitude and may in itself turn the scale against the patient.

#### EXCISION OF REDUNDANT CÆCUM AND ASCENDING COLON FOR EXTREME CONSTIPATION

DR. W. A. DOWNES presented a man thirty-four years of age, who had suffered from extreme constipation for many years. About one year before admission to the hospital, patient had pain in right upper quadrant of abdomen, radiating to back and shoulder, occurring most frequently during night. No nausea, vomiting or jaundice. During attacks he would have frequency and urgency of micturition. Micturition gave him some relief. Bowels averaged one movement a week. Stomach was lavaged and he was advised to take cathartics which had no effect on him. Seven weeks before admission, he went to Bellevue Hospital where he was treated six weeks.

## EXCISION OF CÆCUM AND ASCENDING COLON

Examination of abdomen showed no rigidity. There was some tenderness on deep pressure over right side, especially over right lower quadrant, where there was palpable a rounded movable mass occupying position of cæcum. Liver and spleen not felt. X-ray examination showed (five minutes after bismuth injection) that the bismuth had travelled back as far as cæcum. The cæcum, ascending colon, and hepatic flexure were distinctly dilated. The sigmoid flexure was markedly elongated.

Operation consisted of excision of the ileocæcal coil with ascending colon and anastomosis of the ileum to the transverse colon. The patient made an uneventful recovery and now six weeks after operation states that his bowels move freely every day without catharsis.

### LARGE HYPERNEPHROMA: WELL FIVE YEARS AFTER OPERATION

DR. DOWNES showed a man forty-five years of age, from whom he had removed a large hypernephroma, five years previously. The fact that so few cases of tumor of the kidney of this nature remain well for any length of time made it seem worth showing his case again. The man is now in perfect health, having gained considerable weight. The tumor which was 8 inches in diameter was removed through a large transverse incision.

It is interesting to know that Dr. Abbe states that a patient from whom he removed a large adenocarcinoma of the kidney some twenty-four years ago remains well at this time.

### EXCISION OF THE CÆCUM AND ASCENDING COLON FOR CARCINOMA

In presenting this case Dr. Downes wished to emphasize the point that a sufficiently large incision should be made in all abdominal cases in which the symptoms were of chronic nature. The patient showed was first admitted to St. Luke's Hospital on October 20, 1915, with a diagnosis of chronic appendicitis, and, as is the custom, one X-ray picture was taken to exclude a stone in the ureter. This picture being negative, the appendix was removed through a McBurney incision.

The patient was readmitted on February 28, 1916, complaining of the same pain which he had had previous to the operation. At this time a bismuth series was taken of the gastro-intestinal tract, and it was very evident that there was a stricture near the hepatic flexure of the colon. He was re-operated and an adenocarcinoma of the ascending colon was found.

This case further illustrates the value of the routine X-ray examination of the intestinal tract in all cases of chronic conditions.

## NEW YORK SURGICAL SOCIETY

### ADENOCARCINOMA OF THE SIGMOID

DR. PARKER SYMS presented a man thirty-three years of age, who was admitted to Lebanon Hospital, December 23, 1915, suffering from acute complete intestinal obstruction. Bowels had not moved in five days; the patient had severe abdominal pain and vomiting. No gas was passed; the abdomen was distended and tympanitic. Dr. Bookman performed a colostomy the day of admission; the result was immediate relief. Before the bowel was opened Bookman explored the abdomen and found a tumor in the lower part of the sigmoid. There was an enormously distended bowel above this tumor, and a good deal of congestion and thickening in the neighborhood of the tumor. Bookman wisely made a colostomy in the upper part of the sigmoid so that the colostomy opening and the tumor might be removed *en masse* at a subsequent operation. This patient had been admitted to the Lebanon Hospital on the 29th of August with a history of intestinal obstruction. At this time he was relieved by enemata. He gave a history of a similar attack six months before that date.

January 13th, Dr. Syms resected the sigmoid and colon, removing the tumor and the colostomy *en masse*. An end-to-end anastomosis was effected by the method described by William Mayo in 1909, which was as follows: After the bowel had been mobilized the desired amount was resected between clamps, and about fourteen inches of the bowel were removed. This included the sigmoid and the lower part of the descending colon. A long tube passed through the lower part of the bowel and out through the anus. The upper end of this tube was left protruding about three or four inches, and was introduced into the upper segment of the bowel. A few interrupted sutures secured the two ends of the bowel together and the bowel was stitched to the tube. By traction on the tube, and by manipulation, the upper end of the bowel was invaginated or telescoped into the lower segment. After this invagination was accomplished a few interrupted sutures were introduced which held the bowel together and the junction was complete. The abdomen was closed, two rubber tissue drains being inserted as a precaution. The patient made an uneventful recovery. There was no leakage at any time. There was slight bowel movement through the tube while it was in place, and complete and satisfactory movements from the time the tube was removed which was on the fifth day.

### TONGS FOR TRACTION IN THE TREATMENT OF FRACTURE

DR. PARKER SYMS showed a new instrument which he has recently devised and which he believes to be superior to the Steinmann pin apparatus. In 1912 at the meeting of the American Surgical Association,

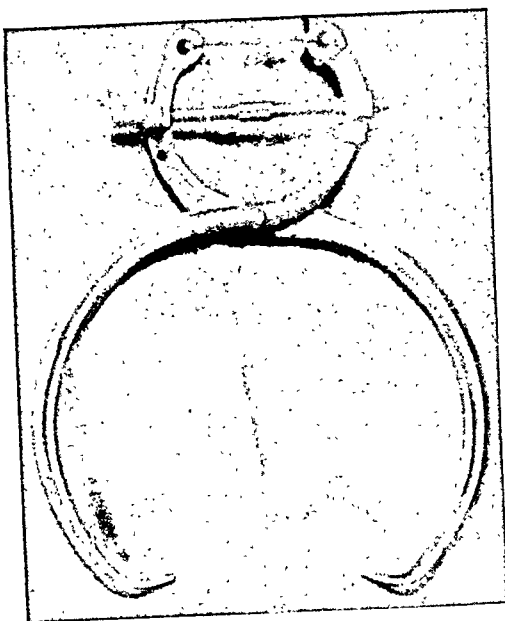


FIG. 1.—Modified ice-tongs ready for use.



FIG. 2.—Showing plaster case applied with tongs still in position.



## EXCISION OF CANCER OF COLON

Dr. J. Ransohoff advocated the use of ordinary ice tongs in the treatment of fracture of the femur. He pointed out the fact that traction applied directly to the lower end of the bone by means of tongs accomplished the desired result in a very definite manner. He showed that by this means one may avoid the damage to the knee joint which so frequently follows the employment of Buck's extension by the old method. He was much impressed with the Ransohoff proposition. Of course, the Steinmann apparatus accomplishes the same object in very much the same way, but it has the objection of the complete penetration of the bone by the pin. The tongs are superior to the Steinmann apparatus because the bone is only penetrated superficially. At Lebanon Hospital the Steinmann apparatus has been used many times during the last two or three years and so far there has been no cause to regret its employment, but serious results have followed its employment in other hands, and its use is not entirely free from danger.

The instrument now shown is modelled from the ordinary ice tongs. Of course, it is very much lighter and more refined. A turn buckle has been added, by means of which the tongs cannot only be held firmly in position after they have been implanted, but from time to time they can be tightened by turning the screw.

Dr. Syms had employed this instrument but once. In that case it was of particular use. It was a case of T-shaped fracture of the lower end of the femur, and it can be readily seen that by screwing the tongs tight together the two condyles were held in apposition and traction was made on the lower end of the femur as if it had not been broken longitudinally. Another great advantage as shown in the accompanying illustration (Figs. 1 and 2) is the fact that a plaster case can be applied while the tongs are in position and while traction is being made. After the plaster has set the tongs may be removed. In the case referred to, he simply stuffed a little sterile gauze into the openings without making any further dressing.

## EXCISION OF CANCER OF COLON

DR. PARKER SYMS presented a specimen of adenocarcinoma of the colon removed by operation, October 26, 1911, from a woman, seventy years of age, who had stenosis at the splenic flexure caused by an annular carcinoma which produced almost complete obstruction. The operation was done as an emergency one. At the time of her operation, patient was on the verge of a broncho-pneumonia which developed after the operation.

The abdomen was opened through the left rectus muscle; the obstruction was found at the splenic flexure. It appeared as a constriction rather than a large mass. The surgical diagnosis was an

obturator carcinoma. On account of the patient's precarious condition the tumor was not removed, but a short circuit was made by anastomosing the transverse colon with the descending colon some inches below the tumor. The patient had a stormy convalescence. Besides her pneumonia she had acute dilatation of the stomach requiring frequent siphonage and lavage. She finally recovered.

A remarkable thing about the case is that the patient made an apparent complete recovery; her anastomosis functionated satisfactorily as was shown by clinical evidence as well as by X-ray pictures. She was able to travel to Europe and about this country, and lived in apparently perfect health for four years.

In December, 1915, she had evidence of abdominal disturbance. There was some difficulty in moving her bowels. However, this was accomplished satisfactorily with enemata and later cathartic. On December 17, she seemed very well in the morning but in the evening she had an attack of violent pain in the abdomen, and died that night from perforation of the bowel above the anastomosis.

This case is reported with the object of showing the advantage of physiological rest in such cases. After a lapse of four years the disease had made no appreciable progress. The diagnosis of the adenocarcinoma was confirmed by microscopical examination in the laboratory of Cornell University.

DR. WIENER said that resecting carcinoma of the sigmoid seems to give a much better prognosis than the removal of carcinoma through other parts of the large intestine. About eight years ago he operated for carcinoma of the sigmoid flexure. The tumor was adherent to the anterior abdominal wall and the omentum, and was about the size of a grape-fruit. He had to resect some of the abdominal wall to get the tumor out. He finally got it out after an hour and a half of pretty steady work; and when he started to bring the ends of the intestine together the nurse exclaimed that the patient was pulseless. So he dropped it with just one suture around it, and stopped, thinking the patient was moribund. The patient did not die, he got better; and after six weeks Dr. Wiener closed the fecal fistula, and the patient went along and remained well. When last heard of, six and a half years after the operation, he was still well, in spite of the fact that he had had what was apparently an inoperable tumor of the sigmoid involving the abdominal wall.

#### FUNCTIONAL RENAL TESTS

DR. EDWIN BEER read a paper with the above title for which see page 434.

## OSTEOPLASTIC RESECTION OF THE SKULL

*Stated Meeting, held April 27, 1916*

The President, DR. CHARLES N. DOWD, in the Chair

### OSTEOPLASTIC RESECTION OF THE SKULL

DR. LUCIUS W. HOTCHKISS presented a man, twenty-one years of age, who was admitted to the medical side of Bellevue Hospital, January 30, 1916, with a history of only two or three weeks' duration. He noticed, without any previous injury or any history of venereal or other disease, that he began to have dull frontal headache which has been continuous and is accompanied with increasing dimness of vision. Once or twice he has had vomiting of a projectile type. On admission he was dull and stupid looking; no scars, pigmentation or eruption, his general physical examination negative. The blood-pressure was from 160 to 180 mm. Hg. As his symptoms continued to grow worse, tumor was suspected and the case was seen by a neurologist who found chronic papillædema, some disorder of the olfactory sense, a distinct weakness of the right facial region,—central type, and slight weakness of the right arm. He became incontinent, was mentally dull but not aphasic, all of which in the opinion of Dr. Kennedy pointed to a lesion of the left side of the brain, probably frontal. Wassermann—negative. Lumbar puncture,—60 c.c. clear fluid under pressure. Cell count—60. Noguchi—positive.

In view of the signs of increasing intracranial tension as shown by the diminution in vision and the condition of the fundus, a subtemporal decompression on the right side was recommended, to be followed later by a broad exploratory operation upon the left side to locate and remove, if possible, the cause of the trouble.

The right subtemporal decompression was done by Dr. Vosburgh with great relief of the symptoms—the headache disappearing and the vision improving. At this operation great intracranial tension was found and relieved—wound healed.

Two weeks later the exploratory operation was proceeded with, as follows: A broad horse-shoe-shaped flap was marked out so as to afford a good exposure of the left frontal region of the brain. The base of the flap was well down upon the squamous plate of the temporal bone where the bony flap was broken through.

The first incision was made parallel to, and a finger's breadth above, the supraorbital ridge from the zygoma to a point three-fourths of an inch from the median line of the skull; the second incision extended



backward from this parallel to the median fissure and about three-fourths of an inch to the left to a point opposite the upper end of the Rolandic fissure. From this a third cut was made, passing across the left parietal and temporal region to a point above the ear, thus marking out a large osteoplastic flap, with a narrow base in the temporal bone, near the base of the skull. The Hudson drill was used to make openings at several points after the periosteum had been pushed back, and these openings were connected by sawing through the skull with a Gigli saw. The large flap was fashioned without much hemorrhage and was fractured at the desired point. When the flap of bone was laid back, it was found that a very wide exposure of the left frontal region of the cortex had been obtained. As there was no evidence of intracranial tension shown by bulging of the dura, and as the patient at the end of an hour showed some shock, the flap was replaced and the search for the possible tumor postponed until a later date.

#### LEFT INGUINAL HERNIA

DR. JOHN B. WALKER presented a man twenty-seven years of age. First noticed a swelling in upper part of left scrotum one year ago; no injury and has not worn a truss. When standing there appears in upper portion of the left scrotum a soft elastic mass which is reduced through the external inguinal ring into the abdomen. The left side of the scrotum is small, undeveloped, and the left testis lies in the inguinal canal just internal to the external ring and between the aponeurosis of the external oblique muscle and the internal oblique and the transversalis and it cannot be brought below the external ring.

Gas and ether anæsthesia. A four-inch incision over the middle of the left inguinal canal, through the skin, fascia and aponeurosis of the external oblique muscle. The sac and cord structures are lifted up. A catgut ligature is passed underneath them and used as a retractor. The sac is opened and found to be congenital. It is separated from the vas and vessels, its neck freed high up, transfixed and ligated with No. 1 catgut. The lower portion is used to form a new tunica for the testis. By very careful dissection the testis is freed from the shortened fascia which has retained and prevented its descent. The vas and vessels are found sufficiently long enough to permit the testis to be brought down into the scrotum. The internal oblique and transversalis muscles are united to the lowermost shelving edge of Poupart's ligament by four interrupted No. 2 chromic gut sutures. The aponeurosis of the external oblique is closed by a continuous No. 2 chromic suture. The skin is closed by a zero plain catgut subcuticular suture.

## CARCINOMA OF COLON

The duration of the operation has been 40 minutes. The patient will remain in bed for twelve days, will wear a bandage for three weeks, after that no further support will be required.

### FRACTURE OF NECK OF FEMUR

DR. JOHN B. WALKER presented a man, fifty-four years of age, moderately stout, who two days ago fell, striking on his left hip. He was unable to rise or to stand when lifted up. He was brought to hospital in ambulance with a Hamilton side splint. Outward rotation was present, also three-quarter-inch shortening. A radiogram was taken which showed an irregular oblique fracture through the neck of the left femur.

The patient was placed on the Hawley extension table and anæsthetized with ether. The patient was drawn down to the perineal post, the perineum being protected by a thick pad; the right foot was attached to the right foot-piece of the extension bar and the right leg was then gently abducted to its normal limit in order to serve as a guide for the injured leg. The left foot was attached to the left foot-piece of the extension bar. Extension was applied until the shortening was overcome and then the leg was abducted to correspond with the normal leg. After carefully bandaging the leg with cotton wadding, a plaster case was accurately applied from the lower border of the ribs to and including the left foot. The left knee was slightly flexed. After the plaster had become solid it was cut through anteriorly from the knee to the toes so as to avoid any undue pressure. The anæsthesia required about thirty minutes. The patient will remain in bed with the case for about five or six weeks. The case will then be removed up to the knee and the patient allowed up on crutches, but the patient must not bear any weight upon the left leg until the end of twelve weeks.

### CARCINOMA OF COLON DISTAL TO SPLENIC FLEXURE

DR. JOHN A. HARTWELL presented a woman forty-two years of age who had been admitted to the hospital two weeks previously, suffering from an acute intestinal obstruction that had been present for five days. At the time no history could be obtained which gave any clue to the cause of the obstruction; accordingly, a suprapubic laparotomy was performed, through which enormously distended coils of small intestine presented. No exploration was possible until these coils were emptied by several punctures with the trocar and cannula, supplemented by suction. The tumor in the left upper abdomen was then palpated and it was determined that the patient's condition would not justify an attempt at its removal. A lateral cæcostomy was performed with a Paul's tube.

The post-operative condition was satisfactory. Fecal discharge was thoroughly established at the end of twenty-four hours, and the patient's condition became such as to justify an attempt to remove the growth. Owing to the cæcostomy wound, and a superficial infection in the suprapubic wound, it was deemed advisable to completely isolate these from the operative field. This was done by covering them with rubber dam made adherent with chloroform, over which adhesive plaster was tightly applied. Before operating this was painted with 7 per cent. iodine, and the usual preparation of the upper part of the abdomen with 3½ per cent. iodine was done. This necessitated the transverse laparotomy incision, which was carried out midway between the umbilicus and ensiform, from the midline to the midaxillary line. The exposure thus obtained was satisfactory, and the final closure of the abdominal wall was without difficulty. The carcinoma was found to be an annular tumor of about two inches in extent, and after removal was demonstrated to leave only a lumen of the diameter of a lead pencil. It was firmly adherent to the peritoneum posteriorly, directly over the kidney. The tumor was approached by dividing the colon 3 inches below it between Payr's clamps, and the two ends were then closed by ligating directly around the bowel just proximal to the clamp, and inverting the crushed and cauterized end inside a purse-string suture of Pagenstecher reinforced with some interrupted Pagenstecher stitches. A lateral anastomosis was then done by means of the Roosevelt clamp, between the transverse colon and the descending colon, the same technic being used as in the ordinary gastroenterostomy.

Dr. Hartwell explained that in doing this no continuous linen suture was used, and that for the hæmostatic suture he preferred the simple through-and-through buttonhole rather than the suture with the loop on the mucosa. Drainage tubes were led out through the lateral extremity of the abdominal incision in such a way that they would provide an outlet in case of leakage from either closed end or the anastomosis.

Dr. Hartwell expressed the opinion that the four or five inches between the anastomosis and the closed end of the splenic flexure would not be the cause of trouble because the reverse peristalsis would very easily prevent undue distention of this portion. In fact it was hoped that this pouch would in some sense act as a reservoir to prevent the too prompt discharge through the anastomosis.

NOTE.—Dr. Hartwell reported the post-operative progress of the patient as satisfactory, and the danger of a fistula seemed to be past at the time of the report. The bowels were moving normally and the fecal discharge through the cæcostomy was almost nothing.

## CHRONIC PERFORATION OF DUODENAL ULCER

### CHRONIC PERFORATION OF DUODENAL ULCER

DR. GEORGE WOOLSEY presented a man thirty-one years of age who was admitted to the hospital April 21, 1916, complaining of pain and tenderness in the right upper abdomen. In May, 1914, he had had his appendix removed; since then no digestive trouble until April 10, 1916, when a burning pain began in the epigastrium, relieved for about an hour by eating. On April 10th, he had a sudden sharp pain in the right subcostal region, persisting until admission as a constant sharp pain, relieved somewhat by lying on right side, and radiating frequently to the right shoulder. When lying on the back there is sometimes pain in the left tenth interspace posteriorly. No vomiting and no blood in stools or sputum. No previous similar attack.

Examination showed considerable tenderness and resistance over the right rectus below the costal margin. The temperature, 101.5 on admission, came gradually down to normal in three days. Test meal showed the following: 60 c.c. recovered; free HCl; total acidity 57; no occult blood. X-ray examination showed a very high arched right dome of the diaphragm, and corresponding to this at the right base, posteriorly and in the axillary line there are dullness on percussion and decreased breath sounds, and vocal and tactile fremitus, from the eighth space down. The tenderness and resistance gradually diminished. The signs pointed to a cholecystitis, the X-ray to a subphrenic abscess or abscess or cyst of the liver. Aspiration of chest was negative.

On operation, April 27th, the pathological findings were as follows: There were recent adhesions all through the right upper quadrant of the abdomen, some of them between the liver and diaphragm, but the dome of the right lobe of the liver was free. On freeing very firm old adhesions between the edge and under surface of the liver, the duodenum, pylorus, omentum and gall-bladder, an old abscess cavity lying between the duodenum and pylorus and the liver and containing about one ounce of pus was opened. Corresponding to this is a sharply outlined, indurated area on the anterior wall of the duodenum, due to an ulcer which at present is closed. Gall-bladder contained no stones but is thickened and contracted, probably due to extrinsic inflammation.

*Procedure.*—The abdomen was opened by a 4½-inch transverse incision on the right side 1½ inches above the umbilicus. The adhesions were separated, the abscess contents sponged out, a posterior short-loop gastrojejunostomy made with two rows of No. 0 chromic catgut, and the gall-bladder shelled out from its thickened coverings. Cystic duct clamped and sutured. A cigarette drain was introduced to abscess cavity and across stump of cystic duct. Wound sutured in layers.

## CHOLECYSTITIS

DR. GEORGE D. STEWART presented a woman, age fifty-one, who has a family history of tuberculosis. Previous history—was treated for tuberculosis at Otisville during the past nine months. Never had typhoid. Menstruation regular. Operated on four years ago for mastoiditis. Three years ago she was seized by sudden pain in right hypochondrium, constant, dull, aching in character, without radiation, relieved on the third day by a severe attack of vomiting, jaundice appeared after the initial attack and persisted for several weeks. Similar attacks have occurred every one or two months since; in all there was pain followed by vomiting and jaundice. The last attack occurred five months ago and was characterized by weakness and loss of weight. Her physical examination showed evidences of tuberculosis over both clavicles; slight tenderness over the gall-bladder, marked tenderness over the appendix. Clinical examinations were not significant. Radiographic examination states that there was nothing abnormal in either urinary tract, but that calculi were present in the gall-bladder.

The operation history is as follows: Moschcowitz transverse incision. Appendix removed (normal diameter at tip but merely a fibrous cord between tip and base). Gall-bladder distended. No calculi. Cholecystotomy. Drain.

Pathological report shows appendix atrophic. Cultures of bile showed colon bacillus.

*Remarks.*—The interesting thing about this case was the utilization of the transverse incision recommended by Moschcowitz for operation in the upper abdomen. It was the first time Dr. S. Stewart has used this incision, and he made it under the direction of Dr. Moschcowitz, who was present. It was easily made, gave a remarkably good exposure and was easily closed.

The fact that the nerve supply was spared and the majority of fibres, both muscular and fascial, with the exception of the rectus, were separated rather than divided, would warrant, it seems, a favorable prognosis as to the occurrence of hernia in the future.

The case was also a tribute to the uncertain value of the X-ray in detecting biliary calculi.

## GASTRIC ULCER—PYLORECTOMY

DR. JOHN DOUGLAS presented a man, age forty-seven, who has had attacks of sharp epigastric pain followed by vomiting for the past seven years. Vomiting relieves pain,—but patient occasionally vomits with-

## EMPHYEMA OF THE THORAX

out pain. Pain bears no relation to the ingestion of food. No hæmatemesis or melæna. Feels well between attacks.

*Physical Examination.*—Negative except for slight tenderness in the epigastrium. String test positive 47 cm. from teeth.

*Laboratory Examination.*—Wassermann negative. Stools negative for occult blood. Gastric contents practically normal. X-ray examination shows perforating ulcer of lesser curvature.

*Operation.*—Vertical incision through right rectus muscle. Indurated ulcer with crater 1 cm. in diameter on lesser curvature about 3 cm. from pylorus found. A V-shaped excision, or a Balfour cautery operation would have caused so much deformity near the pylorus that a pylorotomy was deemed the operation of choice. This was done by the typical Billroth No. 2 method with a posterior gastrojejunostomy, using chromacized catgut throughout.

Convalescence was uneventful. There was no postoperative vomiting, and no leakage or drainage from the wound.

## EMPHYEMA OF THE THORAX. MAJOR THORACOTOMY AND MOBILIZATION OF THE LUNG

DR. HOWARD LILIENTHAL presented a man, twenty-four years old, who had been admitted to the Fourth Division at Bellevue Hospital on April 18, 1916.

His temperature was 102 degrees. Pulse 120. Respirations 24.

The illness for which he was admitted began about January 10, 1916, with lancinating pain in the left side of the chest, dyspnoea, cough and, later, vomiting. Gradually progressive weakness. No night sweats. Continuous pain.

Physical examination showed flatness over the left chest with absent fremitus. Heart displaced to right.

Urine 1034, no albumin or sugar. Few hyaline casts.

Blood 18,600 leucocytes, 72 per cent. polys., 20 per cent. lymphocytes.

Probatory aspiration yielded thick pus which on culture showed streptococci.

X-ray showed from the back, fluid, from the front, fluid, to the fourth interspace, air above. Well-marked level fluid line.

In nitrous oxide and oxygen anæsthesia administered by Dr. Doran, a long seventh interspace incision was made down to the pleura. The chest was then emptied through a small incision into the thoracic cavity, using the suction machine.

Pleurotomy then continued to the anterior axillary line or a little

beyond it. Rib spreader put in, but it was necessary to cut the seventh and sixth ribs at their angles in order to gain sufficient room to work, the left chest being much contracted by the thickened pleura. Lung covered by tough but not very thick membrane. This was incised from above downward and other incisions were made at right angles to the first. The membrane was stripped away but not removed. Lung slightly wounded at several points but good expansion secured. Gauze drainage at the angle of the wound.

### EMPHYEMA OF THORAX

DR. LILIENTHAL presented a man, who had been operated upon for left empyema of the thorax by rib resection in the posterior axillary line, in January, 1916.

There had been continued drainage of large quantities of pus and the patient was in poor general condition.

X-ray showed collapse of lung with large pleural effusion.

Two weeks before, Dr. Lilienthal had operated, making a long intercostal thoracotomy in the seventh interspace and cutting the sixth and seventh ribs posteriorly. The rib-spreading retractor was inserted. The lung had been found covered by a tough thick membrane which obliterated all landmarks. This membrane had been incised from above downward and again in two places across the first line of incision. The lung now expanded nicely and the wound was closed except for gauze drainage at the site of the original thoracotomy. Two days later the gauze had been replaced by a tube put in for the next forty-eight hours and then removed. The patient had done remarkably well and the wound was entirely healed except for a small granulating area not connecting with the thoracic cavity.

The operation which Dr. Lilienthal performed is recommended as a substitute for the more dangerous and crippling thoracoplastic procedures.

### APPENDICITIS WITH DECEPTIVE SYMPTOMS

DR. SETH M. MILLIKEN presented a woman, age twenty-three, who was admitted to the Fourth Surgical Division of Bellevue Hospital, January 29, 1916, with a history of sudden sharp pain in the epigastrium which radiated to the right side, followed by nausea and vomiting. On admission she had a leucocyte count of 20,600, with 80 per cent. poly. There was a slight tenderness at McBurney's point. Her mother did not "approve of operations" and consent was refused. The next day the

## FRACTURE THROUGH THE NECK OF RADIUS

blood-count was 14,200, 74 per cent. poly., with no local symptoms. She remained in the ward one week and was discharged with a diagnosis of appendicitis. She was readmitted on April 26th, with a recurrence of the pain in the right side. Her blood-count was 6500, 59 per cent. poly. There were no abdominal symptoms, except slight tenderness about McBurney's point and slightly above it.

*Operation.*—Iodine preparation. Paramedian incision about three inches long, the cæcum easily exposed and appendix delivered. There were no adhesions. The appendix was very large, acutely distended and injected at the distal end and the tip showed beginning inflammatory necrosis. Fine Pagenstecher hæmostatic purse-string inserted above the base of the appendix, after ligating mesenterium. Appendix amputated with cautery, stump inverted, purse-string closed. This was covered in with a fine catgut figure-of-eight suture. The pelvis was normal to palpation. Wound closed without drainage.

Time of operation, 23 minutes. Gas-ether anæsthesia, 40 minutes.

At the end of the fourth day, patient's condition was perfectly satisfactory, wound clean.

*Second Case.*—Woman, age nineteen. Seven weeks ago had attack with pain, nausea and vomiting, the pain shifting to the right side. She was in bed two days, did not come to the hospital. Present attack began two days before admission, which was April 26th. On admission, her blood-count was 14,000, 79 per cent. poly. There was slight tenderness in the lower right side. No resistance, no mass. Vaginal examination showed intact cribriform hymen. Rectal examination showed uterus small, in normal position, no masses in fornices. Did not appear sick.

*Operation, April 27th.*—Iodine preparation. A three-inch paramedian incision, enlarged upwards and downwards to allow exploratory palpation, which revealed no abdominal abnormality. The cæcum, easily delivered, showed a very long not inflamed appendix with a slight constriction at the very tip making it pointed. The appendix was removed as in the previous case. Wound closed without drainage.

On the fourth day, she had been entirely relieved of her pain and has no symptoms of any sort.

Operation was 40 minutes. Anæsthetic, gas-ether, 48 minutes.

## FRACTURE THROUGH THE NECK OF RADIUS

DR. T. A. SMITH operated upon the following case:

L. G., male, 12 years old, admitted to Bellevue Hospital April 21st. Five days before admission child fell down several steps, striking on



## NEW YORK SURGICAL SOCIETY

the flexed elbow. There was much swelling, discoloration and pain, and after five days of treatment at home for a sprain of the elbow he came to Bellevue Hospital. Examination showed right elbow much swollen, discolored and tender; tenderness most marked over head of radius; no crepitus. Pain on flexion and extension of elbow, and extreme pain when forearm is supinated and pronated.

X-ray shows transverse fracture of neck of radius with forward dislocation of head of bone.

*Operation.*—Vertical incision of posterior aspect of joint directly over head of radius. Joint opened, and upper fragment found displaced forward lying crosswise to the shaft and entirely detached from orbicular ligament.

It was thought best to remove the head of the bone rather than to attempt reposition of the fragments. This was done and the wound closed; the elbow flexed at right angles and held in a sling without splints; passive motion to be begun on the third or fourth day.

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## EPITHELIOMA IMMEDIATELY FOLLOWING SINGLE BURN

BY THOMAS R. CHAMBERS, M.D.  
OF BALTIMORE, MD.

THE case herein reported is considered worthy of being placed on record because of the rarity of such occurrences, and because of the bearing such cases have on the question of the etiological factors in the development of cancer. The history of the case follows, with a brief review of the literature bearing on the subject.

The patient, F. C., male, American, aged fifty-five, fireman in steam laundry, came under our care on February 3, 1916, with the following interesting history. Complaint: Sore on right wrist.

*Past History.*—Negative. Has never had injury or any type of lesion on right wrist, excepting present condition.

*Present Illness.*—Four weeks ago patient, while shovelling coal into furnace, touched back of right wrist against side of furnace door, causing a rather deep and painful burn. Has been treating same at home, but as wound apparently will not heal, comes for treatment.

*Physical Examination.*—Situated on dorsum of right hand at base of thumb in anatomical "snuff box," there is a small irregular raised tumor about  $2.5 \times 2$  cm. This tumor is ulcerated in the centre with a slight semi-purulent discharge. The growth seems to be a part of the true skin and can be moved freely over the underlying structures. Its general appearance resembles very much the so-called pipe-smoker's cancer, or epithelioma of lower lip. At time when first seen by us there was no pain associated with the growth. No lymphatic glands involved.

*Diagnosis.*—Epithelioma. Excision advised.

*Treatment.*—Iodine technic under local anæsthesia. Growth and fair margin of surrounding apparently normal tissue excised. Wound sutured.

*Pathological Report* (by Dr. Standish McCleary, Path. Lab. Col. of P. and S., Baltimore).—The tissue is 2 cm. long by 1 deep. It consists of skin and a slight amount of subcutaneous tissue. The surface is covered with stratified squamous epithelium which on the margins is somewhat thickened. In the middle the epithelium is quite thin and consists of only the upper layers of the normal epidermis, the basal and prickle-cells being absent. Where the attenuated epidermis is confluent with the thicker portion an invasion of the underlying dermis is plainly seen. The dermis is infiltrated by columns of epithelial cells and contains typical "cancer nests" surrounded by a stroma rich in fibroblastic elements and round-cells. These nests extend as deep as the lowest sweat-glands. The epithelial cells in these nests are typical, both in appearance and arrangement of squamous-cell epithelioma. In the larger nests the basal cells are at the periphery, next come the prickle-cells with the spines well shown, and "pearls" are to be seen in these larger nests. There is a well defined layer of sound tissue beneath the invading growth and the margins include uninvolved tissue, so that it would appear that the growth has been entirely included in the tissue sent to me for examination. The specimen is a typical squamous-cell epithelioma.

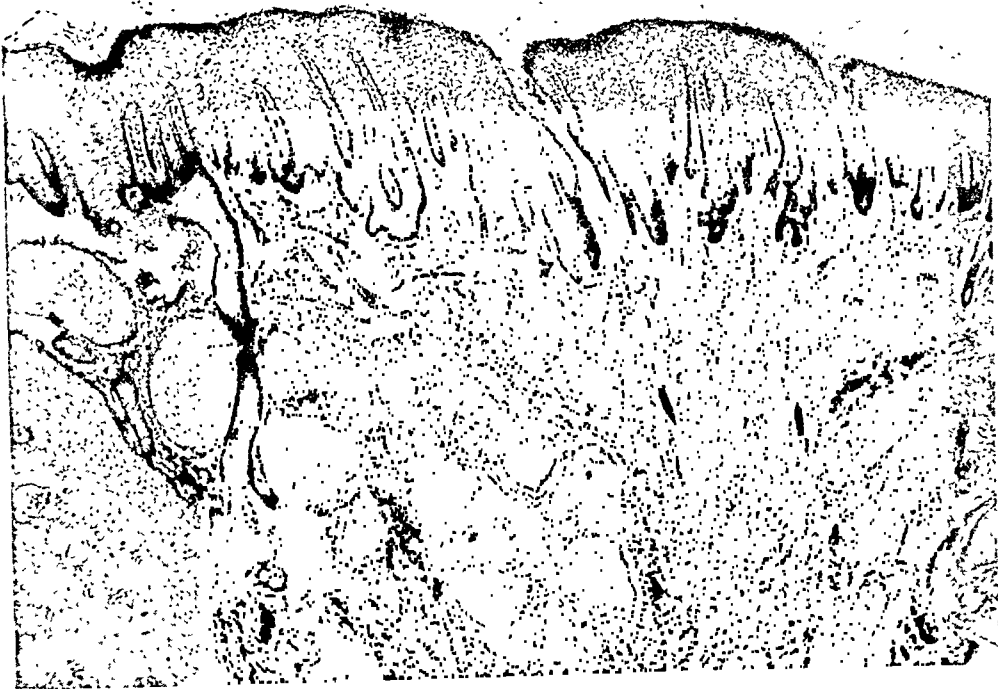
The importance of preëxisting local conditions in the etiology of malignant growths has been much emphasized of late, and the significance of the so-called "precancerous lesion" is generally accepted. The literature is so rich in articles dealing with this general question that we shall confine our attempt now to a brief consideration of those papers dealing more or less directly with the relation between burns and the development of malignancy.

Coley,<sup>1</sup> who has made an extensive review of the literature up to 1910, on the relation between various forms of trauma and malignancy, reports 970 cases of sarcoma, of which 23 per cent. give a history of some form of trauma, and of these, 2 were traced to chemical burns, 1 was due to carbolic acid, and the other to the application of arsenical paste to a pigmented mole. It will be noted that no instance of thermic burn is found in this collection of cases. He also reports 250 cases of carcinoma with a history of trauma in 32.8 per cent., none of these having a burn as the etiological factor. There are several articles dealing with the occurrence in Kashmir of the so-called Kangri-burn cancer. Davis,<sup>2</sup> in a paper on paraffin cancer, quotes E. F. Neve,<sup>3</sup> who has reported 484 cases of this form of epithelioma. The growths are attributed to the constant application of heat to the abdomen and thighs of the natives of Kashmir, who carry the Kangri or portable fire-basket under their clothing for purposes of warmth. Davis suggests that the irritation of soot and gases from these stones may be as much a source of the resultant epithelioma as the heat. In any event the

FIG. 1.



FIG. 2.



FIGS. 1 and 2.—Showing epidermal invasion of underlying dermis; also shows "cancer nests."



## EPITHELIOMA FOLLOWING BURN

condition is one of long-continued and constant application of the local irritant, whereas the case here reported followed directly upon a single burn. In this same article by Davis, a case of paraffin cancer is reported and the literature on chemical irritation as a cause of cancer is reviewed. Da Costa <sup>4</sup> cites the case of an epithelioma arising in the cicatrix of a burn, but fails to state what interval elapsed between the burn and the development of the growth, or what type the burn was, or whether it had completely healed. Apparently the occurrence of cancer in brand-scars in animals is not exceedingly rare, as Cleland <sup>5</sup> reports such a case, the growth developing in the scar many years after the branding. In text-books of surgery, scars of old burns, as other scars in general, are noted as foci for the origin of malignant growths.

It is to be noted that no case that we have found reported presents the following features of this one: A growth following upon a single thermic burn, of structures apparently previously healthy, the development of the growth taking place within less than a month of the burn, without the healing of the original lesion.

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## TOTAL BONE GRAFTS INTO SKULL DEFECTS \*

BY ADDISON G. BRENIZER  
OF CHARLOTTE, N. C.

VIEWED in the light of the results of experimentation and bone grafting done in man in the last few years, it is remarkable that so few cases of total autoplasmic bone transplants into skull defects have been reported in the literature. Up to October, 1914, Rhodes<sup>1</sup> claimed that, so far as he could find, his four cases of large total graft into the cranium were the first to be reported. McWilliams<sup>2</sup> cites two cases reported by Paul Mueller<sup>3</sup> where pedicled sternum flaps were used to fill skull defects, but these operations were unnecessarily complicated for the reason that free grafts have been proven equally successful and that the pedicle offers little advantage in the establishment of a new blood supply to the graft. McWilliams mentions a case of Schroeder where he transplanted a piece of the scapula into the skull, also a case of Tomita where he transplanted a piece of tibia with periosteum into the skull, and finally quotes Funke<sup>4</sup> who says that in all small defects of the skull the autoplasmic graft is to be preferred above all other methods. There may be other cases, but I have not found a report of them.

This paucity of reports is all the more remarkable when the ease of execution of the grafting, as compared with grafting in other parts, is considered. With the aid of a set of modern bone instruments like those of Dr. Charles Geiger (Fig. 1), allowing the cutting of bone shells, inlays, wedges and nails, almost any required bone transplant may be fashioned in size and shape to fit a given defect in the skull; the defect in the skull may also be fashioned to help fit the transplant. Moreover, the structural conditions for the reception, for the support in a fixed position and for the blood vascular supply are all good and favorable to the life of the grafted bone.

Defects in the skull show little spontaneous tendency to become filled with bone; they are filled with scar tissue, with little ingrowth of bone from the edges. This ingrowth from the edges is usually irregular and not under control, as is the case with defects in long bones. Both my cases to be cited directly were of six and fifteen years' duration, respectively, both had been previously trephined and both showed but little growth of new bone around the edges and that irregular. The same cases showed an even filling out with bone and a limiting at the site of the former periosteal periosteum at the location where the bone trans-

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\* Read before the North Carolina State Medical Society, May, 1916.

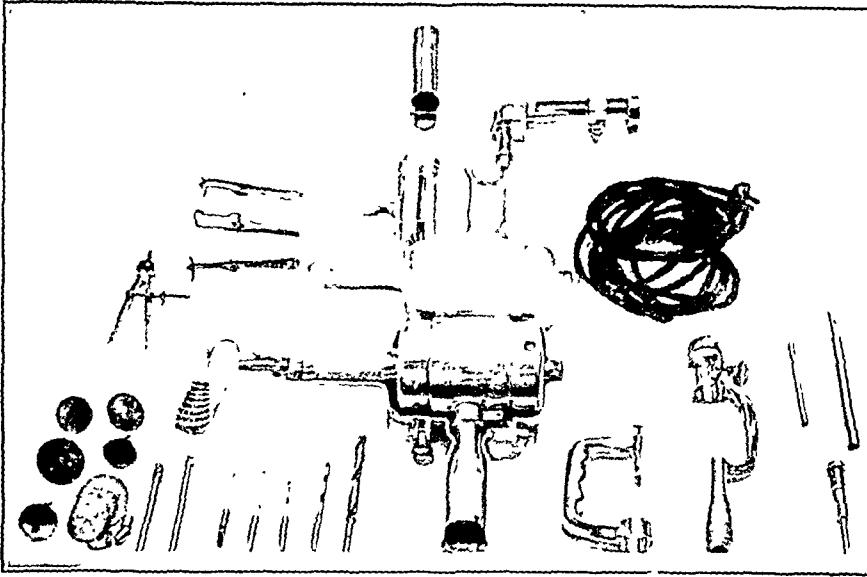


FIG. 1.—Some modern bone instruments showing a sterilizable motor and connecting cord, circular saws, twin saws, trephine, burrs, drills, spiral bone cutter, dowel cutter; with guards, lathe, etc., for the same. Every part can be sterilized by dry and moist heat. (Chas. Geiger.)

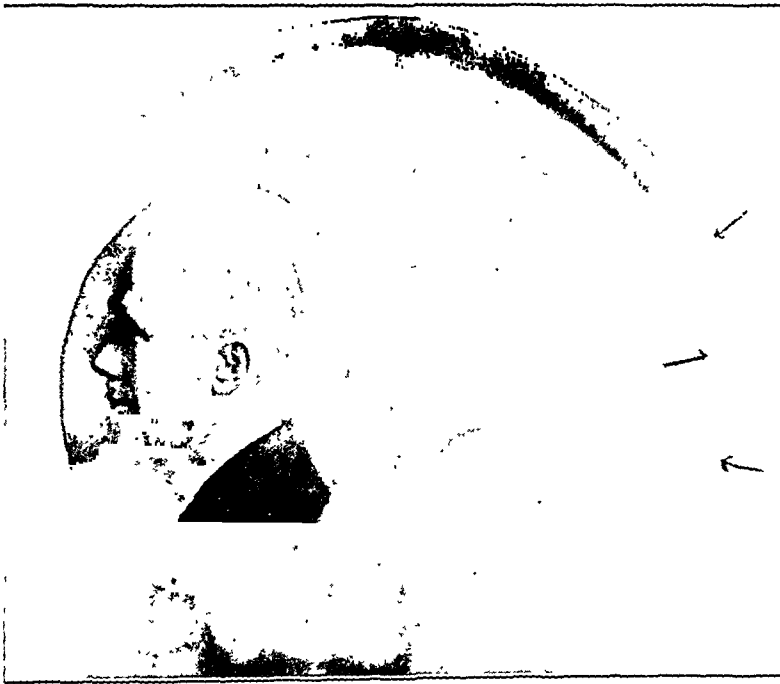


FIG. 2.—Case II. Six weeks after the operation and the site of the old skull defect filled in by the bone transplant. (Brenizer.)



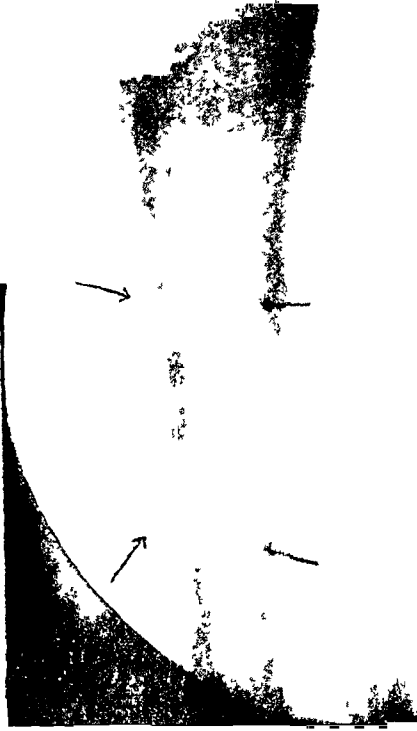


FIG. 3.—The site where the graft was taken from the left tibia. The origin of the graft is well filled in and smooth even after six weeks. (Brenizer.)



FIG. 4.—Case II. Two weeks after the operation, showing the site of the old skull defect filled in by the graft from the patient's left tibia. (Brenizer.)

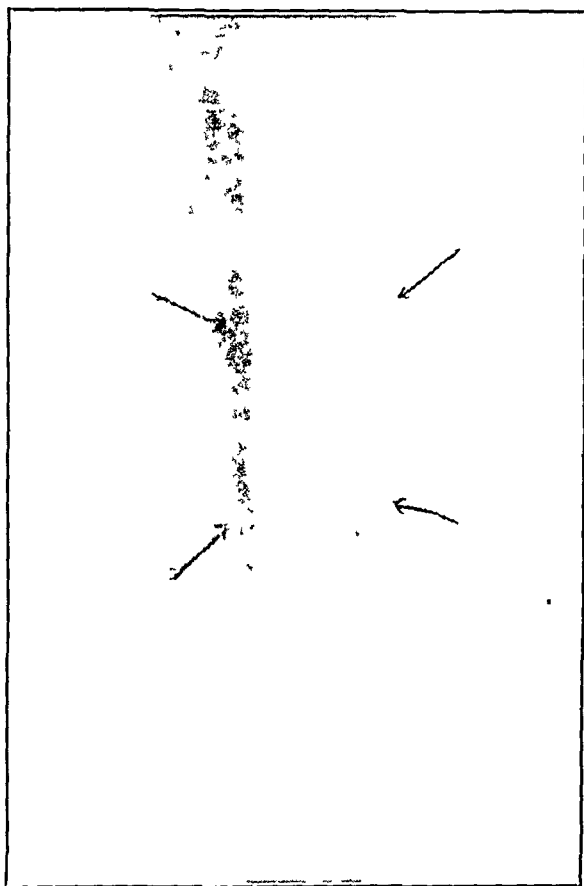


FIG. 5.—Showing location on the inner surface of the left tibia where the graft was taken (Brenizer.)



## TOTAL BONE GRAFTS INTO SKULL DEFECTS

plant was taken from the tibia. (I believe a new periosteum is formed from the bordering connective tissue and the underlying bone cells. But why this remarkable shaping and control of growth in the case of long bones and the failure in the case of the skull?)

The bone edges surrounding skull defects are stimulated to greater activity in new bone formation by celluloid plates, bones from other animals, and boiled and living bone from other individuals. Numerous such cases have been reported successful in the beginning, but the ultimate outcome has been left obscure in most cases. Funke<sup>4</sup> had one case of a celluloid plate which developed a sinus after ten years and at the second operation, at that time, he found the plate broken and the consistency changed. These plates never become completely surrounded by bone. Albee<sup>5</sup> claims that metal even inhibits bone formation, produces bone absorption and favors infection. "The bone graft apparently acts always as a stimulus to osteogenesis to the bone into which it is ingrafted or contacted" (Albee). "The inner layer of the periosteum, the endosteum, and, to a much less, if not negligible, extent, the lining of the haversian canals provide the cells for the osteogenesis in bone repair, to which may be added the comparatively few bone cells in the graft itself which survive" (McWilliams).

Both of these factors, (a) the stimulation of new bone formation in the surrounding bone through contact with the graft, and (b) the growth of new bone from the constituents of the graft itself, are of great importance in filling skull defects where the surrounding bone, otherwise, shows little tendency to spontaneously reform. The degree of difference of new bone formation in response to the stimulating graft on the part of the skull as compared with that of a long bone, I do not know; the growth of the grafted bone in both instances would be in no way inhibited.

"The graft should be living, free or pedunculated, with as much periosteum covering as possible and also containing endosteum and marrow, and the graft should be autogenous; that is, taken from the patient who is to be grafted. It seems certain that if the graft be made according to these rules nothing further is necessary to insure success, save the attainment of asepsis and the maintenance of immobilization" (McWilliams).

CASE I.—A man thirty-five years old, whose head was severely crushed in a railway accident six years previously. At this time the head was trephined and some bone splinters removed. Shortly after this he developed "spells" when he would lose consciousness and "spasms" mostly on the opposite side. Speech slow; apper-

ception dull. There was a large depression over the left side of the skull, the soft parts drawn down tight and the bone deficient over an area about 4 cm. by 6 cm. The soft parts were loosened up, the scar tissue removed, the callus around the edges cut away and the edges bevelled at the expense of the outer table. Into this defect was grafted a rectangular bone shell taken from the tibia, cut and bevelled to fit. A few stitches were placed to unite the periosteum of the graft with that of the skull, and the wound closed. The graft was covered with periosteum and was cut just to the marrow cavity. Fig. 2 shows a picture of the man six weeks after the operation and the site of the old skull defect filled by the bone transplant. Fig. 3 the site where the graft was taken from the left tibia. The origin of the graft is well filled in and smooth even after six weeks. The case was operated on about a year prior to date, and I heard from the man a few days ago that his head was well closed and that he had not had a "spell" in a number of months.

CASE II.—A man twenty-two years old, kicked in the head by a mule fifteen years previously. Some bone was removed, some came out from time to time, leaving his head sunken in. He formerly dragged the leg on the opposite side and dropped words. Had great deal of headache and pain over the depression. Head was trephined a year ago, symptoms better for a while, again worse. Depression and opening in skull about 3 cm. by 4 cm., the soft parts were drawn down and attached. The soft parts were liberated, scar tissue and callus removed, dura freed and the edges bevelled to receive the graft taken from the left tibia. Fig. 4 is a picture of the patient two weeks after the operation and of the site of the skull defect filled in by the graft, and Fig. 5 the location on the surface of the left tibia where the graft was taken. The man after four weeks reports himself improved.

The chances of fracture of the tibia after the removal of the graft are not very great if the patient takes reasonable care of his leg for a few weeks, as the area quickly becomes filled with bone and is made strong.

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# PARTIAL EPIPHYSIAL TRANSPLANTATION FOR DEFECT IN FIBULA

REPORT OF CASE UNDER OBSERVATION OVER FIVE YEARS

BY JOHN STAIGE DAVIS, M.D.  
OF BALTIMORE, MD.

*Introduction.*—The recent appearance of an excellent paper by S. L. Haas,<sup>1</sup> on "The Experimental Transplantation of the Epiphysis, with Observations on the Longitudinal Growth of Bone," has prompted the report of this case of partial epiphysial transplantation.

Haas<sup>2</sup> gives a critical review of the experimental work on this subject. In his conclusions he finds that the epiphysial cartilage after transplantation degenerates and loses its power to functionate.

The results of clinical reports are analyzed in an article by Jost,<sup>3</sup> who says that the few clinical cases on record have not been under observation for a sufficient length of time to determine whether the transplanted epiphysis will survive and functionate, or whether it will die.

I have been unable to find in the literature a case which had been observed for longer than a few months, so it seems worth while to report the following case, which has been under observation for over five years.

If any conclusion can be drawn from the observation of one case, this length of time will undoubtedly have been sufficient for the permanent changes to have taken place.

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<sup>1</sup> Haas, S. L.: Jour. Amer. Med. Ass., December 4, 1915, p. 1965.

<sup>2</sup> As there were no isotransplants in Dr. Haas's series, I will outline a group of experiments which I carried out in the fall of 1911. Fifteen isotransplantations were done on dogs. One-half and one-third joints with the corresponding portion of the epiphysial cartilage and adjacent sections of the shaft from 1.5 to 3.5 cm. long were transplanted. The animals were of about the same size and age, and the distal extremity of the radius was used in each instance. The time elapsing between operation and examination of the specimens was from 73 to 141 days. In each experiment absorption was noted in the transplant, with degeneration of the epiphysial cartilage, and subsequent shortening of the bone and deformity on that side. These experiments were checked by X-ray before and after operation. The conclusion might be drawn that the transplantation of isoeiphyses is hardly worth trying clinically.

<sup>3</sup> Jost, O.: Beiträge zur Osteoplastik an den Extremitäten, mit besonderer Berücksichtigung des Verhaltens der Epiphyse. Beitr. z. klin. Chir., 1915, Bd. 95, p. 116.

CASE REPORT.—I. S., a white boy, ten years old, in the Crippled Children's Hospital, was referred to me by Dr. R. Tunstall Taylor. Two years previously his left leg and foot had been badly mangled by an electric car.

*Examination* (March 20, 1911).—The much mutilated foot was at right angles to the leg, but was markedly everted.<sup>4</sup> The outer portion of the lower half of the leg and foot was covered with a dense, tightly adherent scar. There was practically no motion of the ankle-joint in any direction. The lower fourth of the fibula was lacking, and the stump could be felt through the scar. There was marked outward bowing of the tibia.

Measurements: Right calf, 27 cm.; left calf, 22 cm.; right tibia, 29 cm.; left tibia, 28 cm.; right fibula, 29 cm.; left fibula 22 cm.

X-ray showed the stump of the fibula to be somewhat thickened above and terminating in a sharp spicule of bone.<sup>5</sup>

There had also been destruction of the outer portion of the tibia adjacent to the fibula defect, as well as about one-fourth of the articulating surface, with a corresponding portion of the epiphysial cartilage above.<sup>6</sup>

*Operation* (March 27, 1911).—Ether anæsthesia. The stump of the fibula was exposed; the periosteum was stripped back and a portion of the tip was removed. A channel was made in the scar tissue from the end of the stump to the outer side of the astragalus, which corresponded as closely as possible to the original bed of the fibula.

The upper extremity of the left fibula was then exposed and split longitudinally, so that a section of bone 6 cm. long was removed, including about one-third of the thickness of the shaft with its periosteum, and a similar thickness of the upper extremity with its epiphysial cartilage. This was accomplished with some difficulty on account of the proximity of the peroneal nerve. The wound was closed. The transplant was then placed in the channel prepared for it, with its marrow surface toward the tibia. The upper end of the transplant and the stump of the fibula were held in approximation by a cuff of fascia removed from the upper

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<sup>4</sup> Before the patient came under my care several attempts had been made to correct the deformity by excision of scar tissue, and by the use of plaster cases.

<sup>5</sup> A comparison of this picture taken two years after the accident with one taken four months after the accident showed remarkably little gain in the length of the stump during that time.

<sup>6</sup> The question arose as to the best procedure to prevent further eversion of the foot. Bone transplantation suggested itself, and it occurred to me that bone with epiphysial cartilage might be of some advantage (in a growing boy), should it turn out that the function of the transplanted epiphysis be preserved.

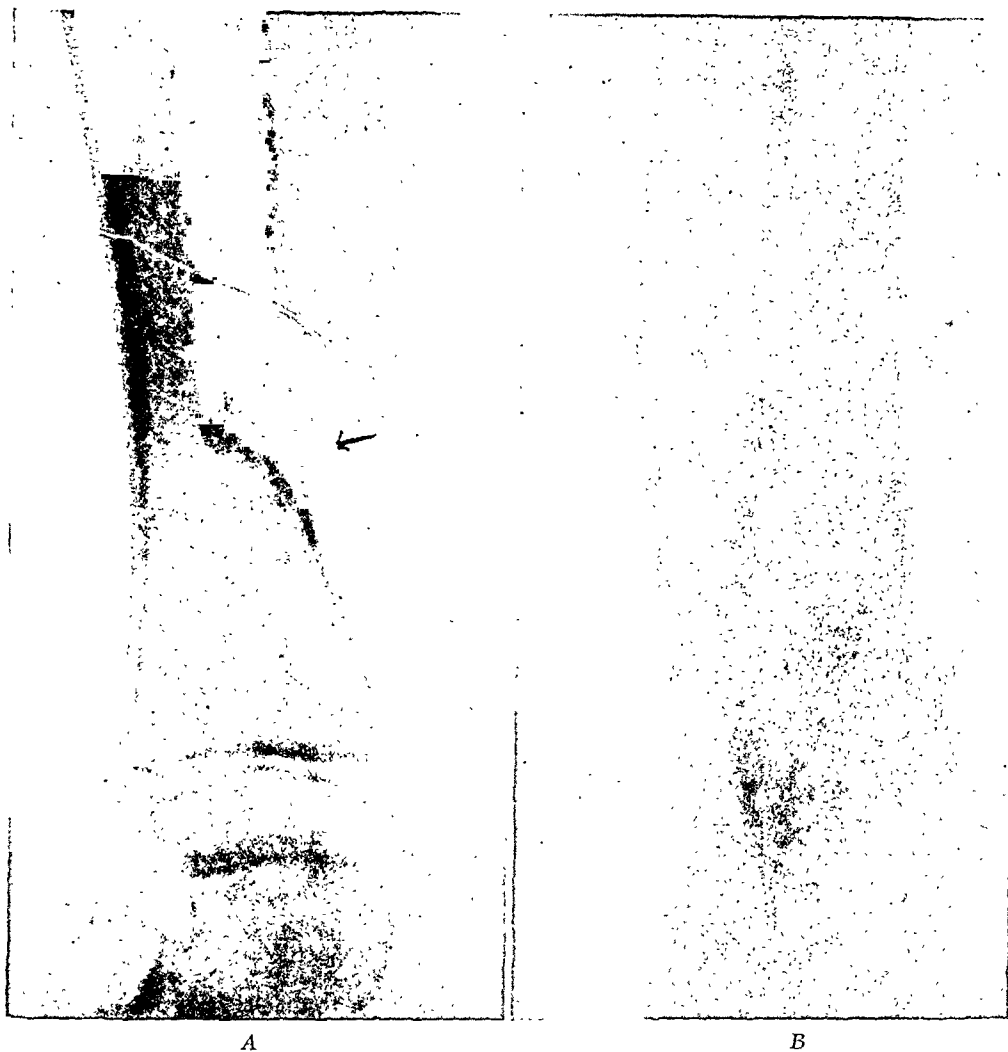


FIG. 1.—July 28, 1909. *A*, X-ray taken four months after accident. *B*, taken before first operation. Note the amount of new bone formation and its small size when compared with the shaft of the fibula.



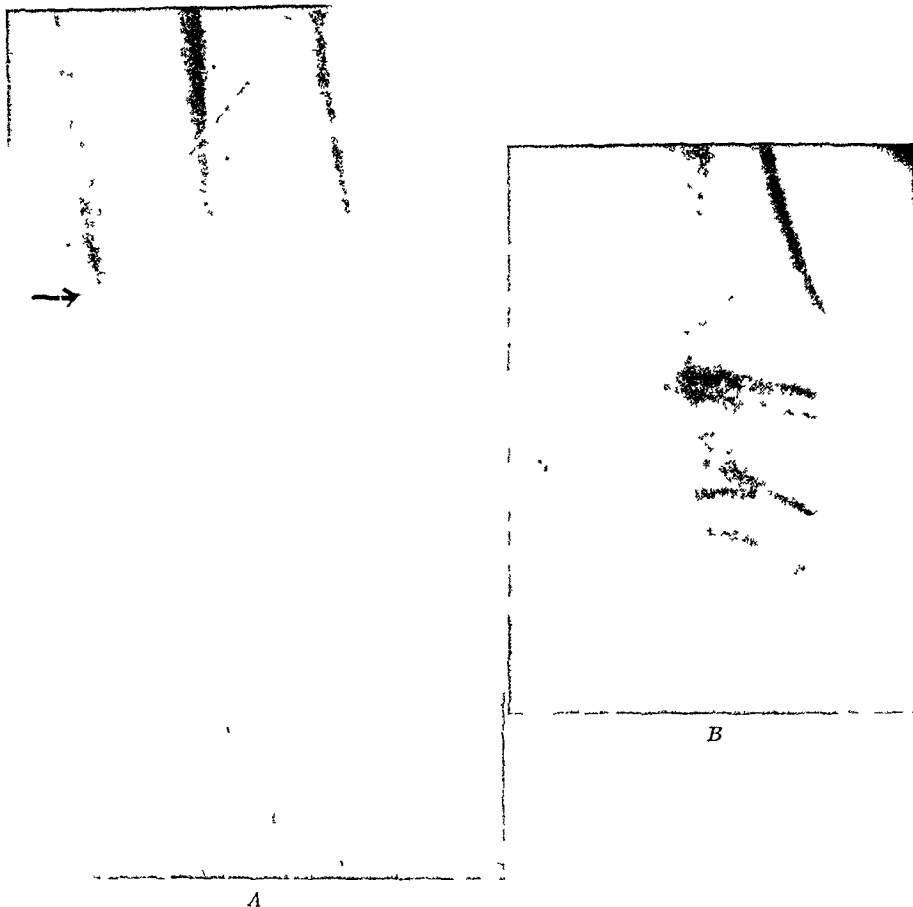


FIG. 2—September 6, 1911. A, there is atrophy of the bones, probably due to the long continued plaster fixation. The graft has united completely with the shaft. The arrow shows the point of junction. The notch 2 cm. below the upper extremity of the transplant is due to uneven cutting when the fibula was split. The epiphysis seems in good condition, and is bent slightly outward. B shows lateral view of the transplant.



FIG. 3—December 16, 1911. A, there is continued new bone formation. The epiphysis is throwing down bone. A small isolated piece of bone can be seen between the epiphysis and diaphysis, and probably is a small living fragment which did not appear in the previous plate. The graft is in good condition. B, February 24, 1912, bone production continues. The disparity between the thickness of the graft and the size of the fibula is diminishing. The medullary canal is beginning to develop in the graft. Cortical bone is being laid down irregularly. The lower epiphysis is developing proportionately. C, the upper epiphysis is in good condition.



FIG. 4.—A, May 24, 1912, the development of the medullary canal continues slowly. There is no cancellous bone at present in the diaphysal part of the graft. The epiphysis is apparently still in good condition. B and C, December 28, 1912, a trace of cancellous bone is seen in the diaphysal part of the graft. The small fragment seen in previous plates is united to the diaphysis. The epiphysis is developing slowly. The upper epiphysal cartilage is still in good condition. Unfortunately this plate was broken.



FIG. 5.—A, May 10, 1913, the grafted portion of the bone, while thin, begins to appear quite normal. The lower epiphysal line is not so sharply defined. At point of junction the medullary cavity is walled off. B, February 14, 1914, the epiphysal line is present, but shows distinct beginning ossification to diaphysis. The medullary canal of the graft is still walled off from that of the shaft of the fibula. C, the upper epiphysal line is in good condition.

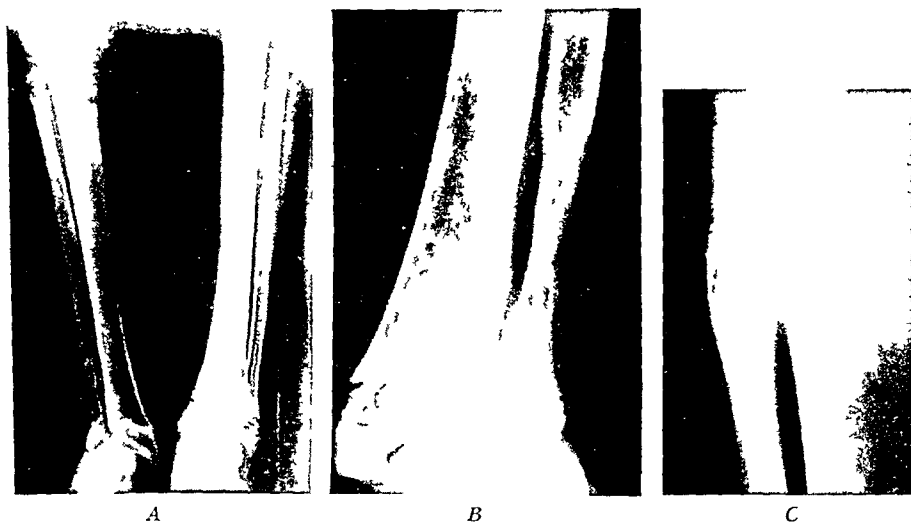


FIG. 6—A, November 6 1915, ossification of the lower epiphysis is almost complete, and further advanced than the normal epiphysis on the opposite fibula. The medullary canal of graft and shaft have joined. The upper epiphysial line is intact and seems to have been little affected by the removal of the graft. B, March 25, 1916, the epiphysial line of the transplant still throws a faint shadow, but the ossification is practically complete. The ossification of the epiphysial line in the tibia is much further advanced than it was in A. There seems to have been a marked increase in the size of the transplant in the last few months, as it now more nearly approaches the size of the normal fibula. The medullary canal is more nearly normal in size, and the cortical bone is thicker. C the upper epiphysial line is apparently normal, and shows that little if any damage was done by removing the transplant.



FIG. 7.—Photograph and X-ray taken March 25, 1916. Note the extent of eversion of the foot.

## PARTIAL EPIPHYSIAL TRANSPLANTATION

wound, and the epiphysial end was held in the position of the external malleolus by a band of free fascia, which was securely sutured to the astragalus. It was found impossible to close the scar tissue over the transplant, so in order to fill the defect and cover the transplant, a free graft of whole thickness skin, with a thin layer of fat, was obtained from the thigh. This graft was held in position with interrupted sutures. The wounds were dressed with silver foil and gauze, over which was placed a plaster cast.

April 17, 1911: First dressing. The sutured wounds had healed *per primam*. The superficial layers of the skin graft were doubtful, and were subsequently removed, but enough retained its vitality to entirely cover the transplanted bone. The convalescence was uninterrupted. The leg was kept in a removable plaster cast, and the patient was up and about on crutches.

June 27, 1911: The continuity of the fibula was unbroken. There was still eversion of the foot, but not as marked as before operation. There was very limited motion of the ankle-joint. Crutches were discontinued.

December 16, 1911: The motion of the ankle-joint was much improved. The boy walked and ran without difficulty. The foot was still everted, but there seemed to be no tendency to further eversion. In order to give more protection to the leg a short brace was ordered, allowing flexion and extension.

December 28, 1912: The patient still wore his brace while at school. The eversion was less noticeable. Flexion of the foot was perfect. Extension was somewhat limited. The outward bowing of the tibia had disappeared.

May 10, 1913: There was slight lateral motion in addition to flexion and improved extension.

February 14, 1914: Condition was excellent. The joint motion was improved.

March 20, 1915: The brace was worn only occasionally. There was no pain in the ankle-joint, and there was no tendency to further eversion. The functional result was good.

November 6, 1915: There was no tendency to further eversion. Flexion and extension were nearly normal. There was also increase of lateral motion.

March 25, 1916: The result after five years was a useful, functional ankle, with practically normal movement. There was comparatively little shortening. There was no tendency to further eversion.

July 8, 1916: The patient was in excellent condition. The motion of the joint was the same as at last note. There was

slightly more eversion of the foot, which may be due to the fact that the left tibia was increasing in length more rapidly than the fibula. During the last eight months the tibia had increased in length 2 cm., while the fibula had gained only .25 cm.

The following measurements, taken at various times, will be considered in a group:

	Right tibia cm.	Left tibia cm.	Right fibula cm.	Left fibula cm.
Before operation .....	29	28	29	22.
July 27, 1911 .....	29	28	29	28
Dec. 16, 1911 .....	30	29	30	29
Dec. 28, 1912 .....	32	31	31	29
May 10, 1913 .....	32.5	31.3	32	29
Feb. 14, 1914 .....	32.5	32	32	29.75
Mar. 20, 1915 .....	34	33	33	31.5
Nov. 6, 1915 .....	35	33	34.5	32.5
Mar. 25, 1916 .....	35.5	34	35.5	32.75
July 8, 1916 .....	36.5	35	36	32.75

Before operation the right tibia measured 29 cm. and the left tibia 28 cm. This difference of 1 cm. can be accounted for by the lack of use of the left leg, and possibly injury to the lower epiphysis. The difference in the lengths of the fibulæ of 7 cm. was due to the destruction of the lower portion of the left fibula.

The measurements taken four months after operation were the same as before operation, except that there was a gain of 6 cm. in the left fibula, which can be accounted for by the transplanted bone. During the next five months there was a gain of 1 cm. in both tibiæ, and of 1 cm. in each fibula.

The succeeding sixteen months showed a gain of 2.5 cm. for the right tibia; 2.3 cm. for the left; 2 cm. for the right fibula, and no gain for the left.

The measurements during the following nine months were unchanged, except for a gain of .7 cm. in the left tibia, and of .75 cm. in the left fibula. Thirteen months later there was a gain of 1.5 cm. in the right tibia; 1 cm. in the left; 1 cm. in the right fibula, and 1.75 cm. in the left. The following seven and a half months showed a gain of 1 cm. for the right tibia, and 1.2 cm. for the right fibula. The left tibia remained unchanged and the left fibula gained 1 cm.

During the succeeding eight and a half months there was a gain of 1.5 cm. in the right tibia, and 2 cm. in the left tibia; of 1.5 cm. in the right fibula, and of only .25 cm. in the left fibula. In short, since operation there was a gain of 7.5 cm. in the right tibia, and 7 cm. in the right fibula. There was a gain of 7 cm. in the left tibia, and 10.75 cm. in the left fibula.

## PARTIAL EPIPHYSIAL TRANSPLANTATION

A series of X-ray plates was taken at irregular intervals, during the period in which the patient had been under observation since the operation.<sup>7</sup> The plates seem to show that the graft had taken in toto.

Three years after transplantation the epiphysial line was still present, although there was distinct beginning ossification. This ossification gradually increased and five years after transplantation it was complete. The ossification was much further advanced than in the normal epiphysis on the opposite fibula. It was also much further advanced in ossification than was the epiphysial line of the upper extremity of the same fibula from which it was taken. The upper extremity of the left fibula was somewhat flattened laterally, but the epiphysial line seemed to have suffered no permanent harm by the removal of the transplant, and was apparently in normal condition when compared with the upper epiphysis of the right fibula. New bone had been laid down and a medullary canal had been formed, which had finally united with that of the shaft of the fibula. The transplant had gradually increased in thickness, both in its diaphysial and epiphysial portions, but even after five years had not attained quite the size of the normal shaft of the fibula.

Unfortunately no attempt was made to have the X-ray plates taken so that exact measurements could be made of the transplanted bone from time to time. However, it is interesting to note that there was an increase in the length of the transplant as measured on the plates taken September 6, 1911, and on March 25, 1916, of only 1 cm. thus leaving a gain of 3.75 cm. in the length of the fibula, in addition to the 6 cm. of the transplant, to be accounted for.

This apparently shows that there was less than one-fourth of the gain in length due to the transplanted epiphysial cartilage, in spite of the fact that the transplanted epiphysial cartilage seemed to survive for so long a period.

*Comment.*—The case is of interest when we bear in mind that there was successful transplantation of bone and epiphysial cartilage, free fascia bands and whole thickness skin, in spite of the fact that the circulation of the scar tissue into which they were transplanted was very poor.

The question arises as to whether the gain of 4.75 cm. in addition to the 6 cm. of the transplant, in the length of the left fibula, up to July 8, 1916, was caused by growth of bone originating from the trans-

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<sup>7</sup> The plates taken two months after the operation and those taken March 20, 1915, were mislaid.

planted epiphysial cartilage, or whether it came from the epiphysial cartilage at the upper extremity of the bone, or from both.

My experimental experience has been that when either extremity of a long bone, including a portion of the diaphysis and the adjacent epiphysis with periosteum, has been removed, there is only an insignificant attempt to fill out the defect, either from the remaining epiphysis or from the stump.

Friederich (quoted by O. Jost, *Beitr. z. klin. Chir.*, 1915, Bd. 95, p. 117) says that after resection of an epiphysial cartilage, the other epiphysis of the same bone can take care of the longitudinal growth. In considering this case we have had destruction of a large section of bone, in addition to the epiphysial cartilage. However, the insertion of the transplant into the defect in the fibula may have produced a condition somewhat similar to that caused by resection of the epiphysial cartilage, and thus have placed this case in the class of cases mentioned by Friederich.

The fusing of the transplanted epiphysis before the time usually assigned for either the upper or lower fibular epiphysis normally to unite to the diaphysis might have been due to the poor blood supply in its new bed; to trauma suffered in the course of transplantation, and also constantly occurring in its new position. The ossification of the left lower tibial epiphysial cartilage was also much further advanced than that of the right tibia, and this might have been due in part to the original injury and also the long-continued fixation and lack of use.

It is impossible to determine definitely from the study of this case whether the transplanted epiphysial cartilage exercised its normal function at all. There was only a very small gain in the length of the transplant in five years, and this gain was considerably less than the total gain in the length of bone.

The upper epiphysis probably has been the marked factor in the increase in length of the left fibula. Considering the time which elapsed before the ossification of the transplanted epiphysial cartilage and the continued steady increase in size, both in the diaphysial and epiphysial portions of the transplant, it seems possible that the transplanted epiphysis might have also had, for a time at least, a small share in adding to the length of the fibula.

## VENOUS ANEURISMAL VARIX

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IN this variety the aneurismal sac is located in the vein itself, and the artery communicates with the vein directly and, through its pulsations, is responsible for the sacculation of the vein. This variety is quite rare, this being the only case met with in a practice of twenty-five years.



FIG. 1.—*a*, communicating artery; *b*, venous aneurism; *c*, coiled varicose veins (actual size) (author's case).

IN the other variety the artery communicates with the vein only after adhesions have formed between them as a result of varicosity and inflammatory conditions. This variety is frequently met with, but the sacculation is usually present in both the vein and artery or else there is an intervening sac, through which the arterial blood passes to the vein.



This case occurred in a rugged, healthy and athletic young man twenty-six years of age. For several years he had noticed an enlargement of the inner aspect of the right knee—sometimes quite distinct, then at times the enlargement would apparently disappear. During the past two years, however, the enlargement remained and, quite frequently, would become so inflamed and tender that he would be incapacitated. This was the condition present when he came to me for advice. Examination at once revealed the true condition, although no distinct bruit or thrill could be detected in the aneurismal sac. The pulsation of the artery, however, could be readily felt. The internal long saphenous vein was involved where it crosses the knee.

February 19, 1916, under local anæsthesia, the varicose vein was removed and the artery ligated. The accompanying drawing (Fig. 1) shows the specimen in detail and is self-explanatory. It was not till the eighth day, after the removal of the first dressing, that I discovered the possible cause may have been lues—there had been not the slightest effort at union of the skin, which promptly occurred after large doses of kali. He previously denied any specific ailment.

His mother and two married sisters had varicose veins of the legs during pregnancy and following confinements.

# SEGMENTAL RESECTION FOR GASTRIC ULCER\*

A PRELIMINARY REPORT BASED UPON CLINICAL AND EXPERIMENTAL STUDIES

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THE problem has arisen in the treatment of gastric ulcer whether the removal of the ulcer-bearing site, which is commonly a saddle-shaped section from the lesser curvature of the pyloric region, or whether the resection of the ulcer-bearing segment is associated with the better post-operative motility. Given an excision operation that has been performed perfectly, technically, its success obviously depends upon the tonus and upon the contractions of the remaining stomach. Moynihan, Von Eiselsberg, and Mayo have called attention to the functional impairment following certain of these operations. W. J. Mayo, in his recent discussion of the surgery of ulcer at San Francisco, declared "the sleeve resection . . . gives an excellent permanent result. . . . Just why this operation, in which the corresponding part of the greater curvature is removed at the time the ulcer is excised, should leave the stomach with good motility while excision of the ulcer without removal of the segment of the greater curvature of the stomach leaves it with poor motility is an interesting conjecture."<sup>1</sup>

The radical operations for gastric ulcer have been

1. Simple excision with knife or cautery.
2. Simple excision with gastro-enterostomy added.
3. Simple excision with gastro-enterostomy and pyloric occlusion.
4. Pylorotomy and partial gastrectomy with some form of gastro-enterostomy.
5. Resection of the ulcer-bearing segment of the stomach ("sleeve" or segmental resection) with or without gastro-enterostomy.

The palliative measures have been the gastro-plastics and gastro-enterostomies alone or combined with the turning in or the strangulation of the ulcerous areas. Bloodgood, W. J. Mayo, Smithies and Ochsner have emphasized the tendency of gastric ulcer to become malignant. Patterson, of London, and others believe that comparatively few of the ulcers of the stomach develop into cancer. The present tendency of surgeons, however, is to treat ulcer as potential carcinoma and

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to add to whatever palliative measure has been adopted excision of the ulcer, thus lessening the possibilities of malignant degeneration.

Briefly, the indication for segmental gastrectomy is the large caloused ulceration. The technic consists in removing a segment of the stomach containing the lesion and in uniting terminally the divided ends. It calls for the removal of more tissues than that immediately involved in the ulcer but less usually than in pylorotomy. For the purposes of studying the motility of the stomach following the excision of the "cuff," the segmental method has been correlated with that of excision of the ulcerous area or "triangular" gastrectomy.

Several segmental resections have been performed.

Of the four cases presented, the first, second, and fourth have had complete gastric segments removed; the third, the ulceration, alone.

CASE I.—J. H., admitted November 29, discharged December 31, 1915, sixty-three years of age, and born in United States of America. Occupation, watchman.

Family history irrelevant. Had rheumatism and venereal infections. Uses tobacco and alcohol. For the past two years attacks of vomiting and abdominal pain. Eructates gas and fluid. Has lost appetite and weight. Urine negative. Blood shows 5,696,000 reds with 80 per cent. hæmoglobin and 10,000 leucocytes with 79 per cent. polynuclears. Wassermann negative. Gastric analysis gives a total acidity of 85 and a free acidity of 54.5 with no blood, Boas-Oppler bacilli or sarcinæ.

*Operation* (December 4, 1915).—By Doctor Stewart. Removed a 2-inch segment of stomach bearing an ulcer of lesser curvature. Ends of completely divided stomach approximated by an inner chromic and an outer Pagenstecher suture. Cigarette drain left in the lesser sac of peritoneum. Uneventful recovery.

CASE II.—N. M., admitted January 6, discharged February 4, 1916, twenty-nine years of age and born in Austria. Occupation, motorman.

Family history negative. Uses tobacco, habits and past otherwise negative. For the past 7 months attacks of nausea and epigastric burning or pain. Pain relieved by eating. Appetite good until just prior to entrance. Loss in weight slight (2-3 lbs.). Epigastric tenderness. Urine negative. Gastric analysis gives 54 c.c. of total and 6 c.c. of free acid, with no blood or lactic acid. Wassermann negative.

*Operation*.—By Doctor Stewart. Removed ulcer-bearing segment and performed gastro-gastrorrhaphy as in above case. Uneventful recovery.

CASE III.—M. F. D., admitted November, discharged December 29, 1915, forty-six years of age, and born in United States of America, occupation, clergyman.

Family and past history irrelevant. For the past fifteen years eructation of burning fluid. For the past 3 months vomiting attacks. Has no abdominal pain. No masses, tenderness, or rigidity in abdomen. Urine negative. Blood shows 7800 leucocytes with 79 polynuclears. Gastric analysis gives a total acidity of .06 and a free acid of .08 with no blood or lactic acid. Wassermann negative.

*Operation* (December 13, 1916).—By Doctor Stewart. Ulcer of lesser curvature of stomach near œsophagus removed. Opening closed with inner chromic and outer Pagenstecher sutures. Two cigarette drains left in. Uneventful recovery.

CASE IV.—A. L., admitted March 28, discharged April 18, 1916, sixty-six years of age, and born in United States of America, occupation housewife.

Family and past history irrelevant. For the past 2 years nausea, losses in weight and in strength. Tender stomach mass distinctly palpable. Urine negative. Gastric analysis shows absence of free hydrochloric acid and no blood or lactic acid.

*Operation* (March 29, 1916).—By Doctor Barber. Adenocarcinoma of the body of the stomach resected and divided ends reunited by inner chromic and outer Pagenstecher. Uneventful recovery.†

The X-rays of all the above have been studied and are given below.

In attempting an experimental study of the motility of the stomach after segmental resection, it seemed wise, first, to review, briefly, the known muscle physiology of the normal stomach and, then, to compare the movements of the resected stomachs. These movements were observed directly before and after the removal of triangles and segments from the stomach walls, and indirectly through the tracings of changes in the intragastric pressure as well as through repeated X-ray findings of normal stomachs and of stomachs after resection.

It is generally agreed that (1) normal gastric prosthalsis begins in the fundus in the vicinity of the cardia, that (2) the stomach is tonic and contracts peristaltically, that (3) this tone and these contractions are subject to certain influences, such as the general health of the individual, the contents of the stomach, the presence, or absence of irritable foci, the quality and the quantity of the blood supply, and stimuli from the vagus and splanchnic nerves, and that (4) normal prosthaltic contractions which begin in the fundic portion terminate in the pyloric end of the stomach.

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†This case is reported under Tumors of the Stomach, Ref. Handbook Med. Sciences, 1916, and is reported here because of its being a most recent segmental resection. Note the preservation of four-hour emptying two weeks postoperative.

The locus of origin of the individual contractions is not (to our knowledge) definitely established. From inspection of the dogs' stomachs under light ether narcosis, it appears to fall on a point, approximately, half-way down the descending arm of the lesser curvature. By different methods, Beaumont,<sup>2</sup> Brinton,<sup>2</sup> Becterev and Mislowski<sup>3</sup> placed the initial contractions at the cardia; Hofmeister and Schütz, "near the cardia;" and Auer<sup>4</sup> "near the oesophageal insertion." It is probable that the contraction actually starts at the cardia but does not become recognizable, macroscopically, until it involves the anterior face of the stomach a short distance distal to the cardiac sphincter.

From this fundic site, the wave is observed to sweep toward a corresponding point on the greater curvature and caudad in successive cross-sections. As it progresses, it keeps fairly transverse to the long axis of the stomach while the rate on the greater curvature is greater than on the lesser. The antral sphincter (three to four fingers' breadth above the pylorus) contracts most forcibly: at least it shows the greatest indentation perpendicularly when viewed anteroposteriorly, and the greatest constriction when examined stereoscopically. Cole<sup>5</sup> has estimated the rate of this gastric cycle in man at 2.5 cm. per second and the time at 2 to 25 seconds. Auer mentions an "angular section of the preantrum" which the peristaltic wave "apparently skips in its course" to the sphincter antri. Brinton's theory of the three streams of the active stomach—namely, one along the greater curvature toward the pylorus, one along the lesser curvature in the same direction, and a reversed medial current—is given added significance by the observations of the return of solid particles from the antrum to the body of the stomach and by the contributions of Jefferson,<sup>6</sup> A. Herz,<sup>10</sup> and Moritz,<sup>11</sup> in respect to the existence of a gastric stream which following the lesser curvature empties at the pylorus.

The reciprocal dependence of the stomach upon the health of the individual is well known. The medical student, worn out at the end of his school year, often finds delay in his stomach which ordinarily empties itself perfectly. This constitutional factor enters into the force of the stomach movements and manifests itself under the same conditions of life in some instances by atony and in others by hypermotility.

The stomach's activity varies periodically according to phases of digestion. The time immediately following a meal divides itself into periods of forcible contractions alternating with intervals of relative quiescence. As the time increases after a meal, the contractile periods increase in length, from 12 min. for the relatively powerful contractions

## SEGMENTAL RESECTION FOR GASTRIC ULCER

to 30 min. for the strong ones. The intervals of rest vary from 5 min. for man (Carlson<sup>6</sup>) to  $1\frac{1}{2}$  to  $2\frac{1}{2}$  hours for the dog (Boldireff<sup>7</sup>). Not only do the contractions of the oncoming activity phases increase in intensity, that is in amplitude and in frequency, but the terminal ones may end in tetanus. Carlson has drawn attention to a continuous rhythm of 20 sec. duration which he believes to spring from the pyloric musculature and to be always present. Both the 20 sec. rhythm and the more forcible stomach contractions disappear with health. According to Alvermann,<sup>8</sup> Rossbach and van Braam-Houckgeest denied that the empty stomach possessed characteristic movements but Hofmeister-Schütz, Moritz, and J. R. Ewald maintain that the same movements take place, only slower and fewer.

A common example of an irritable focus is the appendix in appendicular gastralgia. The stomach is the spokesman for many diseases located elsewhere, more or less remotely, in the alimentary canal. For a given period of health, in response to these stimuli, the stomach changes in the tone of the cardia which may become a cardiospasm, in the tone of the pylorus which may become a pylorospasm, possibly in the tone of the body of the organ which may be a true gastrosplasm, and in the tone of the sphincters and the body, combined, which may be a true gastric tetany.

The quality of the blood, obviously, to some degree characterizes the stomach's activity. Carbon dioxigen may be an essential factor in stomach tonus. When increased in amount, it possibly may account for some of the instances of inexplicable acute dilatation of the stomach. The influence of asphyxia upon the gastric tonus is pointed out by Morat<sup>12</sup> in 1880, by Battelli<sup>13</sup> in 1896, and, probably, again, by the following experiment:

An apparently normal dog is induced to swallow a rubber bag and tubing. The animal is put under light ether. The tubing is connected up with a tambour and chloroform manometer and through these with a kymograph. (The apparatus is similar, in principle, with that used by Morat in 1882, by Battelli in 1896, and Carlson at the present time). The contractions observed, under these conditions, are represented in tracings 3, 4, and 5. Note that decreased oxidation or asphyxiation is associated with intermittent contractions of short duration as compared with those of the normally aerated animal.

The influence of the extraneous nerves upon the automatic activity of the stomach has been demonstrated by Bayliss, Schütz, Unger, and others. Bayliss's<sup>14</sup> illustration of smooth muscle tonus by means of the "catch" mechanism is particularly suggestive.

Because of the relations of the vessels and nerves to the stomach's activity, many of the research studies in which these structures have

been disturbed necessarily present sources of error. That many of the involuntary activities do persist for a limited time in tissues removed from the body is well known, but that such manifestations are normal remains to be proved. In the following observations, it will be found that motor activities from the individual under mild ether corresponded fairly well with the kymographic tracings from the voluntary animal with the intragastric bag, and with the X-ray findings. The clinical studies compare favorably with these experimental data.

The dogs, times of operation, the operative proceedings, and the subsequent histories are tabulated in Table I. The "subsequent report"

TABLE I

Dog No.	Date of operation	Operation and operative observations	After-history
58	No record	Segmental resection; duodenostomy	No methylene blue from duodenal stoma 2 hr. 45 min.
77	January 13, 1916	Triangular resection	Traced 41 days later.
78	January 13, 1916	Resection of neuromuscular triangle	Traced 41 days later.
92	January 19, 1916	Triangular resection	Records incomplete.
93	January 19, 1916	Triangular resection	Etherized for morphological study; stomach <i>dilated</i> .
101	January 27, 1916	Resection of neuromuscular segment	Died 14 days later; intragastric hemorrhage; size of stomach <i>normal</i> .
103	January 27, 1916	Resection of neuromuscular segment	Died 15 days later; nephritis; stomach <i>contracted</i> .
115	February 3, 1916	Resection of neuromuscular segment	Died 37 days later; pneumonia; stomach <i>contracted</i> .
114	February 3, 1916	Segmental resection and fascial transplant	Traced 46 days later; X-rayed 41 and 42 days later.
127	February 10, 1916	Segmental resection; rate of prostatic wave 20 sec. for 10.9 cm. or 1.83 cm. for 1 sec.	Traced 46 days later.
128	February 10, 1916	Segmental resection; time of prostatic wave 21.7 sec.	Died 40 days later of pneumonia; stomach <i>moderately dilated</i> .
151	February 24, 1916	Segmental resection; time of prostatic wave 11.4 sec. for 6.25 cm. or 1.8 cm. for 1 sec.	Traced 23 days later; X-rayed 21 and 22 days later.
152	February 24, 1916	Triangular resection; time of prostatic wave 8.9 sec. for 2.5 cm. or 5/18 cm. for 1 sec.	Traced 25 days later; X-rayed 20 and 21 days later.
184	March 16, 1916	Triangular resection; time of prostatic wave 14.7 sec.	Traced 30 days later.
206	March 30, 1916	Segmental resection	Died 27 days later; pneumonia; stomach <i>slightly dilated</i> .
233	April 13, 1916	Segmental resection	Traced 4 days later; 15 days later reported in good condition.

## SEGMENTAL RESECTION FOR GASTRIC ULCER

### SUBSEQUENT REPORT BEARING UPON THE RELATION OF DILATATION OF THE STOMACH TO MECHANICAL CONSTRICTION AT THE SITE OF THE GASTRIC WOUND

Dog No.	Autopsy findings on April 20, 1916	Wave counts during stage of analgesia
114S	Size of stomach normal; size of resected portion admits two fingers	Cycles of av. 30.9 sec. duration.
151S	Stomach moderately dilated; resected portion admits one finger	Cycles of av. 20 sec. duration.
78T	Stomach markedly dilated; resected portion admits one finger-tip	Died, apparently of malnutrition.
152T	Stomach moderately dilated; resected part admits two fingers	Died, apparently of malnutrition and of confinement.
184T	Stomach moderately dilated; resected part admits one finger	Cycles of av. 21.3 sec. duration.

S refers to segmentally resected dogs; T, to those with triangles removed. The animals do not do well under conditions of confinement within doors. For respective lengths of post-operative life, compare above chart.

reveals what mechanical obstruction, if present, were found in two segmentally and three triangularly resected dogs.

From this series, it appears that ten animals were examined post-mortem after two weeks to over two months of postoperative life. Of these, three were triangularly and seven segmentally resected dogs. The stomachs of the former were noted as "moderately" dilated in two and "markedly" in one; the stomachs of the latter as "normal" or "contracted" in four, "slightly" dilated in one, and "moderately" dilated in two. Furthermore (and this comparison is not to be given much importance because of the limited number of observations), the times of the prostaltic waves immediately following triangular gastrectomies were 8.9 sec. and 14.7 sec., respectively, and the rate (in one)  $\frac{5}{18}$  cm. per sec.; after segmental gastrectomies, the times were 21.7 sec. and 11.4 sec., respectively, and the mean rate (in two) 1.8 cm. per sec. If these findings, taken in themselves, have any significance they represent the segmentally resected dog's stomach as the more motile during life and the more normal after death. The intercurrent affections are to be considered as contributing causes or more properly end-results of mortality in the above instances.

During the brief period of observation (immediately after anastomosis of the stomach ends and before closure of the abdomen) the waves seemed slower, shorter, and certainly less distinct in the animals with the triangles resected from the lesser curvature of the pylorus, and more rapid, more forcible, and longer in those with complete cuffs removed from the region of the pyloric incisura. In the former, the contractile wave was not recognizable until the region of the greatest contraction was reached, but in the latter the wave could be first seen at the mid-point on the descending arm of the lesser curvature. In both, the wave



was not traceable beyond the gastric wound and the pyloric end remained relaxed as well as amotile.

TABLE II  
SHOWING RESULTS OF TRACINGS OF INTRAGASTRIC PRESSURE  
TECHNIC SIMILAR TO CARLSON'S

Dog No.	Time after eating	Forcible contraction	Continuous contraction and duration	Tonus changes
77T	1 hr.	Absent	Weak and 20-40 sec.	None observed.
78T	2½ hr.	Absent	Weak and 20-50 sec.	Present.
114S	20 min.	Present	10-20 sec.	Present.
127S	1 hr.	Present	Absent	None observed.
151S	2 hr. 20 min.	Present	10-20 sec.	Present.
152T	20 min.	Absent	15 sec.	None observed.
184T	25 min.	Absent	10-20 sec. and weak	None observed.
206S	(See Table I)			
233S	50 min.	Present	10-20 sec.	Present.

In Table No. 2 presenting the deductions from the tracings of eight dogs, each of the animals recorded was taken from a similar environment, fed a similar meal, and traced from 20 min. to 2 hr. 30 min. thereafter for periods ranging from 30 min. to 4 hr. The record, therefore, simply denotes what the stomach is doing with the bread and water meal for the short interval studied. It is seen that under these conditions, the animals with segments removed show forcible contractions and tonus changes and that the dogs with triangles resected generally do not. Both, however, give evidence of continuous rhythm. Under the conditions of laparotomy, the dog's stomach was observed to contract continuously (as pointed out above), presenting, in effect, a one- or two-cycle stomach. (Compare this picture with that of the normal dog with the bismuth-milk meal.)

It is evident that with an air-distended bag in the stomach contraction from any part of the gastric wall can influence the contained air—that is, the bag is not selective in its transmission of changes in intragastric pressure. The motility of the gastric segment aboral to the gastric wound is not differentiated. The tonic condition of the pyloric portion was noted at operation and its subsequent dynamic condition has been studied by the X-ray.

Röntgenographically, one normal and two pathological dogs and four pathological human cases have been reviewed. The findings are given below and explain themselves.

The normal dog (Fig. 5) shows a two-cycle stomach, a well-demarcated pyloric region, and a duodenal cap (dog No. 185). The stomach is practically free from bismuth (300 c.c. bismuth-milk emulsion) in

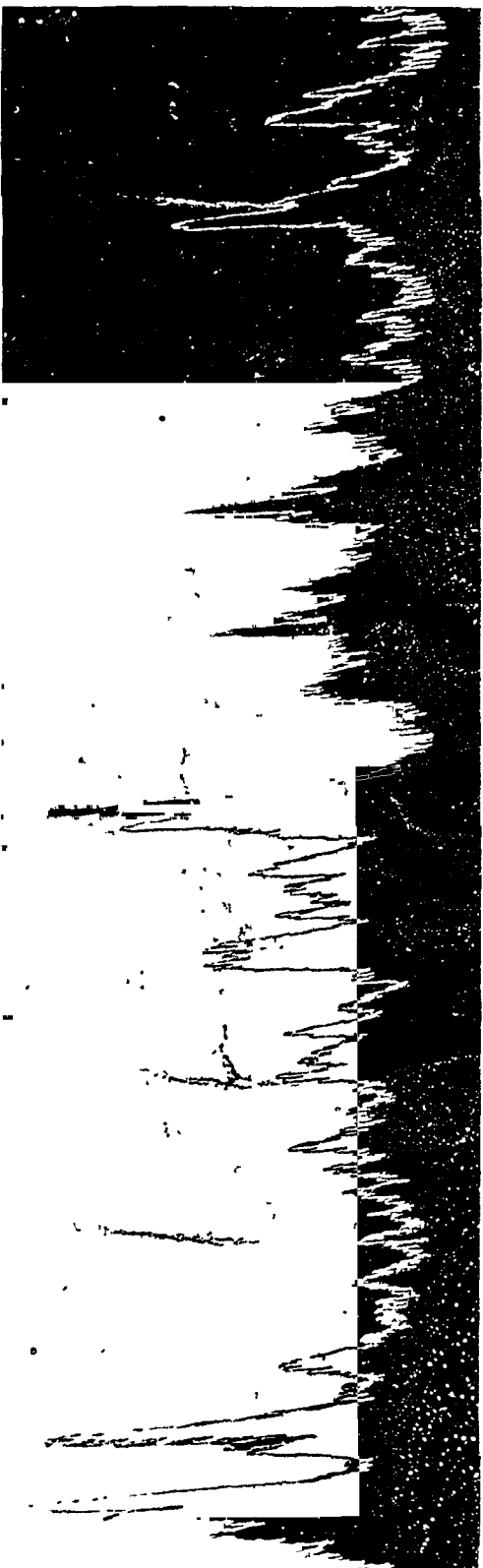


FIG. 1.—April 17, 1916. Dog No. 233 S. Traced 50 min. p.c. for one-half hour (portion of tracing).

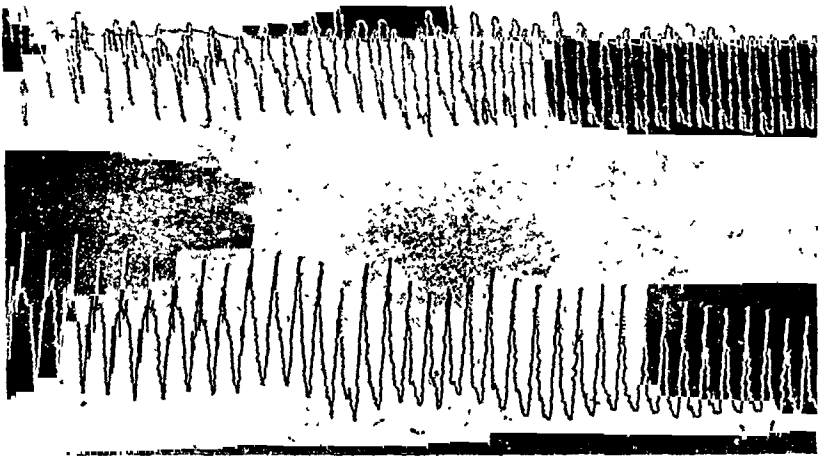


FIG. 2.—Normal dog, (1) under ether, (2) breathing, (3) with abdomen closed.  
Note continuous contractions.

2 sec interval -



FIG. 4.—February 21, 1916. Normal dog under ether, apnoëic, with abdomen opened. Note incontinuous contractions of average ten seconds, with rest intervals of ten to fifty seconds duration, respectively. (Tambour tracing above, chloroform below.)

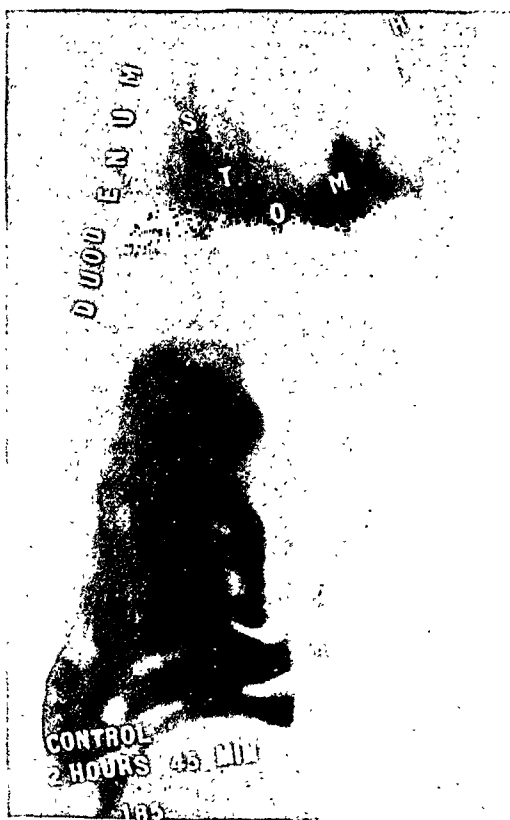


FIG. 5.



FIG. 6.

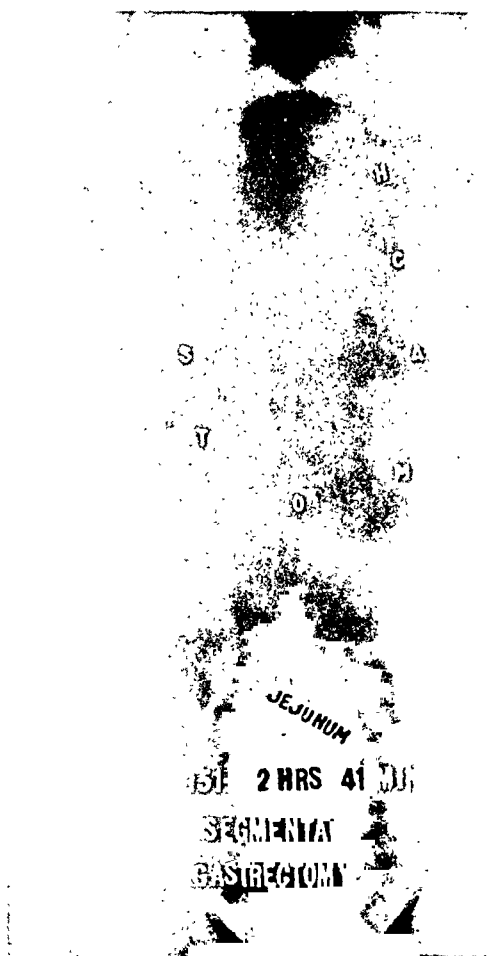


FIG. 7.

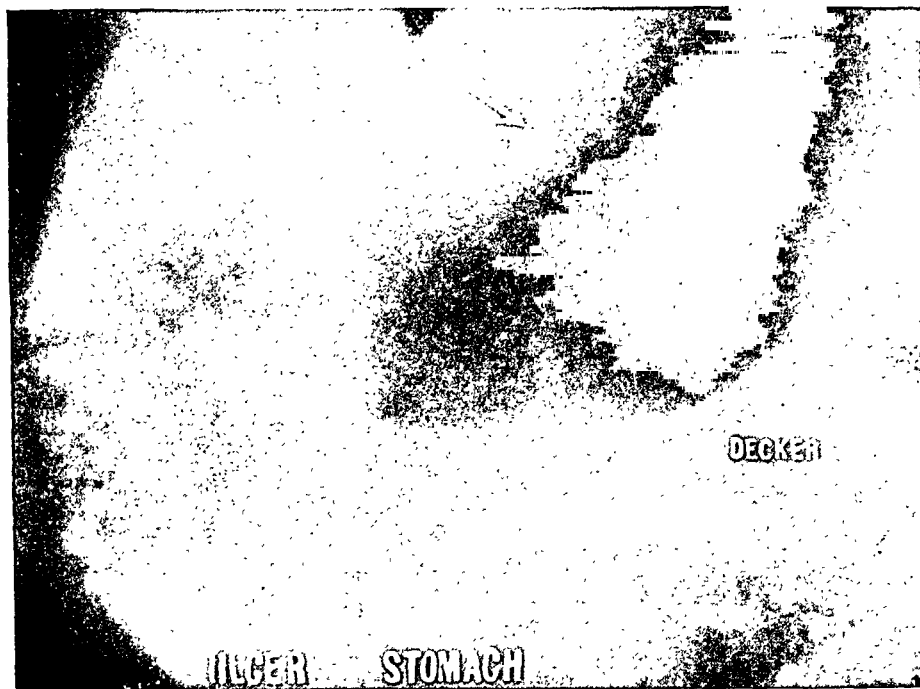


FIG. 8.—Case III.

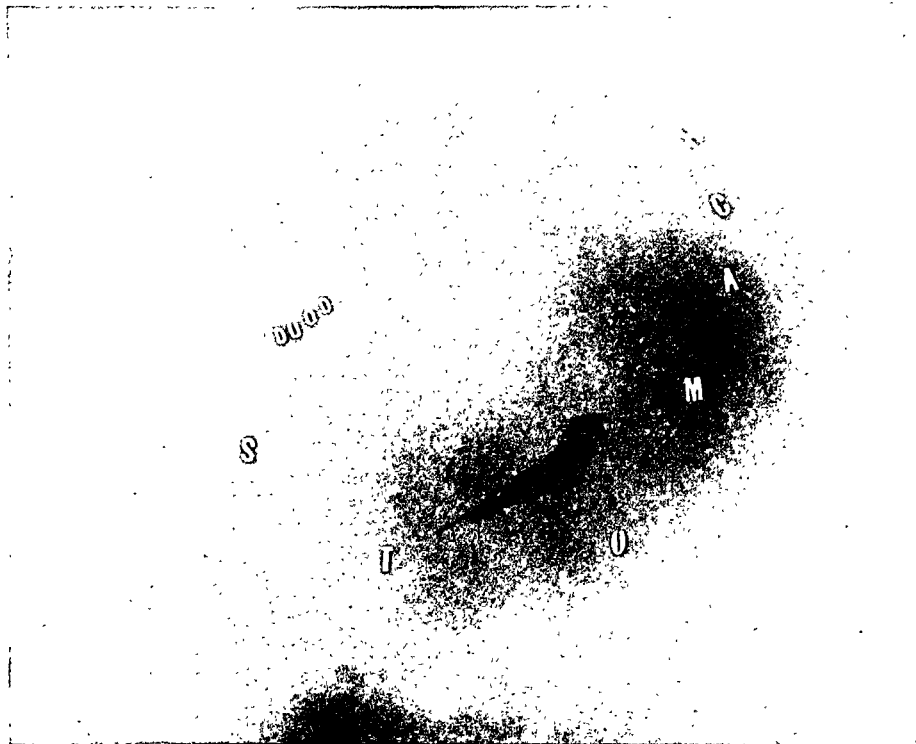


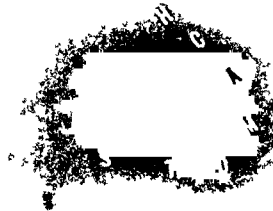
FIG. 9.—Case III.



MAN-10-10  
PHONE  
13  
LISTON  
45824

NEW GROWTH - STOPPING

FIG. 10.—Case IV.



LEVEL OF UMBILICUS

APR 3 1941  
PHONE  
LISTON  
45824

2 WEEKS AFTER RESECTION OF STOMACH

FIG. 11.—Case IV.





## SEGMENTAL RESECTION FOR GASTRIC ULCER

3 hours and 20 minutes and the alimentary tract in (less than) 25 hours.

The dog with the triangle removed (152) (Fig. 6) shows a dilated stomach with no duodenal cap and a retention of most of the bismuth in 2 hr. 51 min. The column has reached the colon in 23 hr. 19 min. The segmentally resected animal (151) (Fig. 7) gives a pyloric region less distinctly outlined but a stomach, not as dilated, which empties 50 per cent. in 2 hr. 41 min. The bismuth is in the colon in 23 hr. 15 min. Dog No. 114, in which a segment was removed and the ends were held apart with a fascial transplant, throws a stomach shadow similar to that of the segmentally resected animal (151). All these three pathologic stomachs show on at least one of the exposures a two-cycle stage, similar to, but less distinctly than, the normal stomach (No. 185).

Case I, before operation, shows evidence of ulcer of the lesser curvature and a six-hour residue; after segmental resection, a pyloric end indistinctly filled out and a six-hour retention. Similarly, Case II, before segmental removal, gives indications of ulcer and a six-hour retention, and after, a forcible stomach with an undescribed pyloric end and a six-hour delay. Case III (Figs. 8 and 9) has an ulcer and a six-hour delay before, and a twenty-four hour retention (Doctor Le Wald's Report) after *triangular* gastrectomy. Case IV (Figs. 10 and 11) is well represented in the accompanying photographs. Note that the emptying time only two weeks after the removal of a large-sized segment from the pyloric end and body of the stomach remains the same as before operation, approximately four hours. (X-ray Report.)

This is a preliminary report upon a very interesting subject. The conclusions herein implied are tentative, and require further clinical and experimental study. The purpose has been to determine, if possible, which of the two methods, the resection of the ulcer-bearing segment or the removal of the ulcerous site for gastric ulcer leaves the stomach with the better postoperative motility. W. J. Mayo's report or implication that the "sleeve" resection is followed by good motility is borne out by the present study, certainly, in so far as the proximal segment is concerned, and apparently in respect to the distal one (compare emptying times of the human stomachs, notably Case IV, and of the dogs' stomachs). All the segmentally-resected stomachs have not emptied quite as effectively as normal stomachs but somewhat more satisfactorily than "triangularly" resected ones (Doctor Le Wald's Report on Case III and on Dog 152), as we hope to show more effectively in a subsequent report. This difference in the emptying times may be due in part to the mechanical relations incidental to the gastrectomies (see Table No.

1, Subsequent Report) themselves, but more probably (observations during experimental operations and postoperative tracings) due, in greater part, to the fundamental disturbances in the neuro-muscular motor mechanisms of the stomachs.

The authors desire to thank Prof. Holmes Jackson, of the Department of Physiology, for constructive criticism in the preparation of this article.

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# INTRAPARENCHYMATOUS HEMORRHAGE OF THE SPLEEN

HEMORRHAGIC SPLENITIS: INTRASPLENIC HÆMATOMA (NON-TRAUMATIC); APOPLEXY  
OF THE SPLEEN: FIBRINOUS TRANSFORMATION OF SPLEEN

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OF GALESBURG, ILL.

Two forms of hemorrhage of the spleen are well known in medical literature, viz.: that which accompanies external rupture, and the so-called blood cysts which are believed to be due chiefly to internal hemorrhage of traumatic origin. By some authors the great majority of non-parasitic cysts are placed in the latter category, and no absolute distinction is made between false and true cystic formations, the last named having a true epithelial lining. Profuse hemorrhage may occur within a true cyst.

But aside from these well-known forms there are others which appear to occupy a position midway between them, which are barely alluded to in standard works. It is understood at the outset that hemorrhagic infarctions, vascular tumors, aneurisms and perhaps other conditions are not to be considered in this connection. But few cases are on record, and it is unfortunate that these are very imperfectly described and illustrated. There is an absence of microscopic findings and of blood counts before operation. The case reports refer to intrasplenic hæmatomas, hemorrhagic splenitis, encysted hæmatomas, parenchymatous or diffuse hemorrhage, intracapsular hemorrhage, apoplexy of the spleen, etc. Generally speaking the extravasation of blood is large, often, extreme. The whole organ, or one of the two poles, may be involved. The bleeding is apparently of the gravescent type in certain cases, oozing taking place gradually and compressing the splenic tissue. This is well shown in the character of the blood seen in some cases. We may see side by side fresh fluid and clotted blood, layers of unorganized fibrin and organized fibrin. In a so-called primary blood cyst in which escape of blood is limited to a single extravasation in one locality, the blood as a rule is quickly absorbed and the cyst which forms later contains only serum and blood detritus. In rare cases this absorption does not take place, or rather perhaps the lesion is seen at a very early stage before absorption could occur. Whether an encapsulated hæmatoma can become a true cyst seems to be undecided.

Much confusion is due to the fact that some of the interior hemorrhages of the spleen are really subcapsular ruptures. In any rupture of

the organ the blood is apt to accumulate beneath the capsule before rupture of the latter occurs, and the tear in the capsule only allows a part of the pent-up blood to escape into the peritoneal cavity. In a certain number of cases the capsular laceration does not occur until some time after the injury (two-stage rupture), and in a few cases does not occur at all. There is no doubt that some intrasplenic hemorrhages so-called are of this character. The accumulation of blood under the capsule may then compress the spleen and in the end the results will not differ from that produced by a purely intrasplenic hemorrhage. It has been the aim of the author to exclude all such cases from consideration.

Of special literature the chief authority is Camus's thesis on "Traumatic Intrasplenic Hæmatoma," which reproduces a large number of cases from literature. The great majority are cysts of traumatic origin and there are also a number of cases of subcapsular hemorrhage. But few cases are examples of internal hemorrhage in our conception of the term.

Of a considerable number of cases in literature which bear a close resemblance at first sight to the author's case, all have been rejected but four, either because of scantiness of data or because they were clearly subcapsular hemorrhages. Of the five cases not one gave any history of malaria, and the obscure nature of the disease in the five may have had some connection with the nature of the hemorrhage. A brief outline of the cases is appended.

Routier's patient was a woman of twenty-four, in excellent health aside from an obscure enlargement of the spleen of some years' duration. She went through a pregnancy without accident. Eight years after the original enlargement, the organ, hitherto quiescent, underwent further swelling and the size of the spleen then increased until it had to be removed as a mechanical nuisance. The organ weighed 3500 Gm. and its tissue had been partly replaced by fibrin and clots, chiefly at the lower pole. In the entire pulp could be seen fresh foci of hemorrhage and small blood cysts. The case was so unique that the author has no explanation to offer. The secondary enlargement of the spleen was apparently due to a diffuse parenchymatous hemorrhage.

A case of Jordan's was quite similar to the preceding. Jordan speaks of it as a "blood cyst," but R. H. Fowler in commenting on the case terms it a hæmatoma. The patient was a woman of forty-six without history of infection or trauma. The spleen had been enlarged for seven years, and was extirpated for mechanical reasons. It weighed nearly 9 pounds and on section hardly any parenchyma was visible—a connective-tissue wall contained only gelatinous masses of fibrin.

Martyn's case is altogether peculiar. He describes it as one of "acute hemorrhagic splenitis." There was no history of splenic trouble and the patient was

## HEMORRHAGE INTO SPLEEN

healthy until the third month of her fourth pregnancy, when she became acutely ill with symptoms which suggested acute pancreatitis and peritonitis. Laparotomy showed error in diagnosis. There was some blood in the lesser peritoneal cavity. The woman became worse and aborted. The abdominal wound was tamponed and the uterus curetted. Later the tampon was removed. The patient continued to grow worse until death set in. The spleen was found enlarged, and both subcapsular and parenchymatous hemorrhage was present. There were several large hemorrhages in the parenchyma, and several communications existed between these and a subcapsular clot. The pulp of the spleen was chiefly soft and necrotic. There was some normal pulp. No round-cell infiltration was found. The case is of special interest as showing that foci of internal hemorrhage may be associated with a subcapsular clot. A slight rupture of the capsule at this point had caused bleeding into the lesser peritoneum.

Di Bernardo's case is as follows: Male, aged sixty years, negative history. Sudden pain in splenic area followed by evidences of tumefaction. Two months later examination and puncture led to the diagnosis of hæmatoma. Laparotomy. Removal of two litres of bloody fluid through a small opening. The entire spleen had been disintegrated and altered by accumulation of blood within the capsule.

We are now in position to report our personal case and compare it with the preceding, with a view of learning whether the five cases represent a separate type of affection or are atypical throughout. As will be noted the author's case is very fully reported, with blood counts and microscopic findings.

**CASE REPORT.**—A. M., thirty-six years old, a native of Illinois; farmer; married, has two healthy children; height, 5 ft. 9 in.; weight, 150 pounds. Referred by Dr. Essex.

*Family History.*—Father died at age of seventy-three; cause unknown. Mother died of blood poisoning, aged about sixty years. Had one brother who had epithelioma of the lip, which was cured by extirpation. Has two brothers and three sisters, living.

*Personal History.*—Is without interest until three years ago when he was "threatened with malaria." No treatment was taken and no malaria developed. He was slight of build but never had to consult a physician, excepting for a bad tooth (pyorrhœa), about three years ago (this probably accounts for his threatened malaria), although for six years he had had periodical attacks of headache in right temple, for which no treatment had been sought.

*Present Illness.*—Patient had complained of feeling tired and weak for about one week; then seventeen days ago, while pulling weeds at 2 P.M., he was seized with a sudden pain in the pit of his stomach. Not a sharp and severe pain, but dull and continuous. He continued his work through the day and all the following day, and until noon of the third day. The pain was continuous and gradually increasing in severity, and on the evening of the third

day it was severe enough to require the administration of morphia, hypodermically. Following this he required from two to six hypodermics daily, and the last few days, hyoscine had been substituted for morphia. With nausea and vomiting the pain gradually worked its way to the left and beneath the edge of his ribs. No hæmatemesis was observed.

*Physical Examination.*—Skin pallid and moist, face drawn, thin and anæmic; tongue coated; pulse 86 and of fair volume; temperature 98.8; respiration 30 and shallow. Head: Features thin, eyes normal, teeth fair; tonsils, thyroid and pharynx negative. Chest: Dulness and decreased fremitus below the fifth rib on left side. Right side negative. Heart: Sounds normal; apex beat, 1 inch to left and above normal position. Abdomen: Left hypochondrium distended and very tender for 2 inches below edge of ribs. Other abdominal organs normal.

## URINALYSIS

Color .....	Dark amber.
Reaction .....	Acid (100 per cent.)
Specific gravity.....	1024
Albumen.....	½ of 1 per cent.
Sugar.....	Negative
Indican .....	Present, large amount
Urea.....	0.03
Mucin.....	Present
Bile.....	Trace
Microscopic .....	Granular casts, few cells epithelium, leucocytes, crystals, calcium oxalate, bacteria (few).

## BLOOD EXAMINATION

Red.....	3,176,000
Per cent. red cells.....	62
Hæmo index.....	.5
Hæmoglobin.....	40 per cent.
White blood-cells.....	130,000
Polymorphonuclear .....	71 per cent.
Large mononuclear .....	20 per cent.
Small mononuclear .....	8 per cent.
Eosinophiles.....	1 per cent.
Red cells, rouletted.	
Many normoblasts present.	

*Diagnosis.*—Hemorrhage into spleen, and decision to operate.

*Preparation.*—Hypodermic of hyoscine, gr. 1/100, morphia sulphate, gr. ¼, one-half hour before operation.

*Operation.*—Ether anæsthesia. Incision left rectus. Findings: Enlarged, tense spleen, adherent to parietal peritoneum,

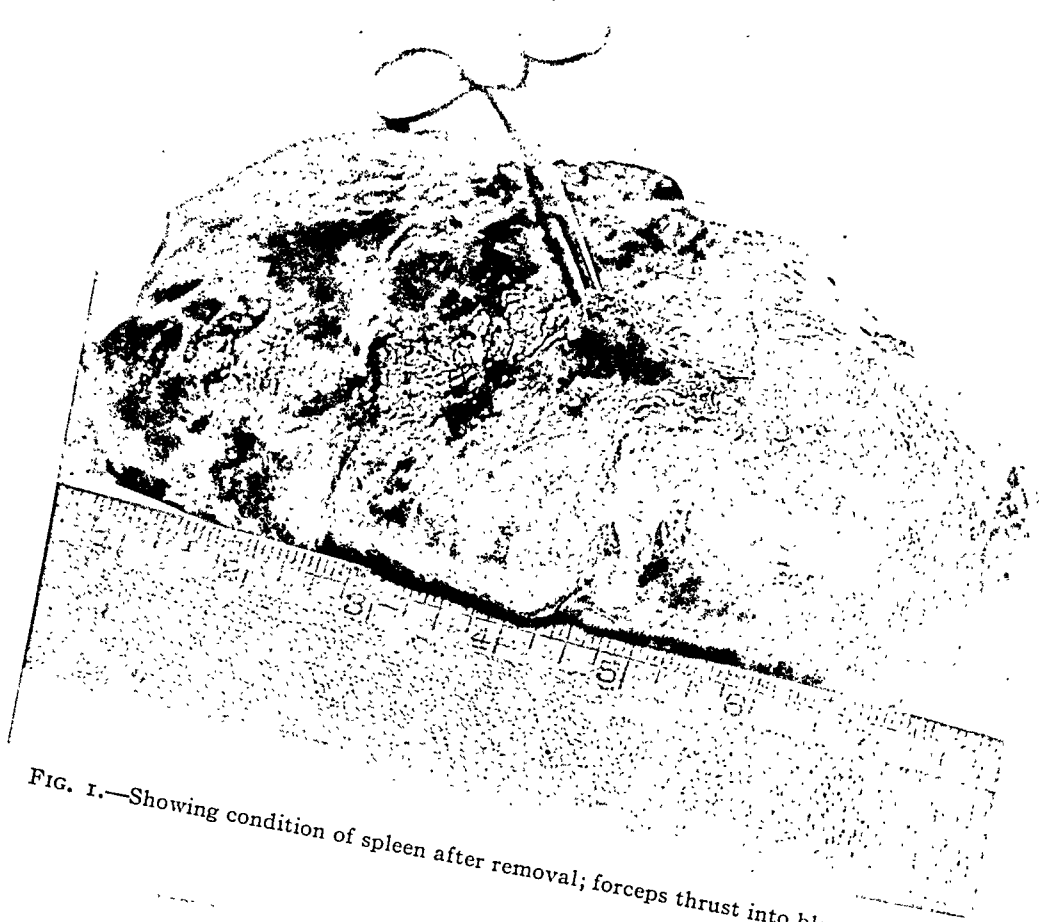


FIG. 1.—Showing condition of spleen after removal; forceps thrust into blood cavity.

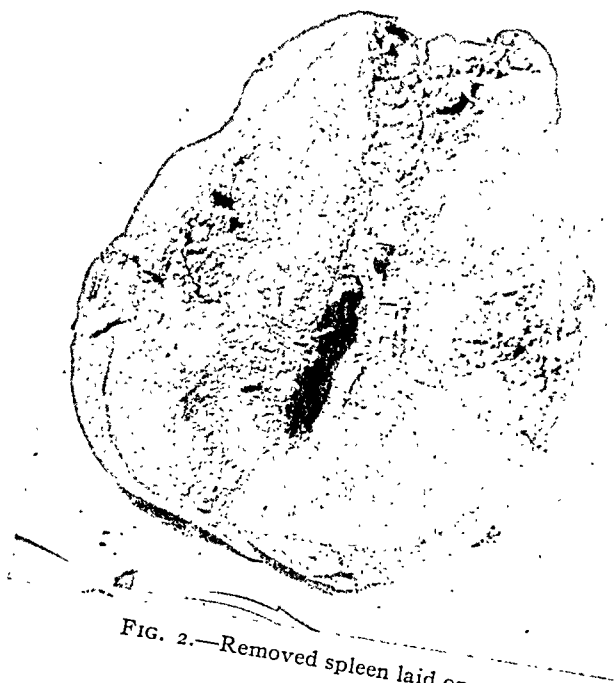


FIG. 2.—Removed spleen laid open.



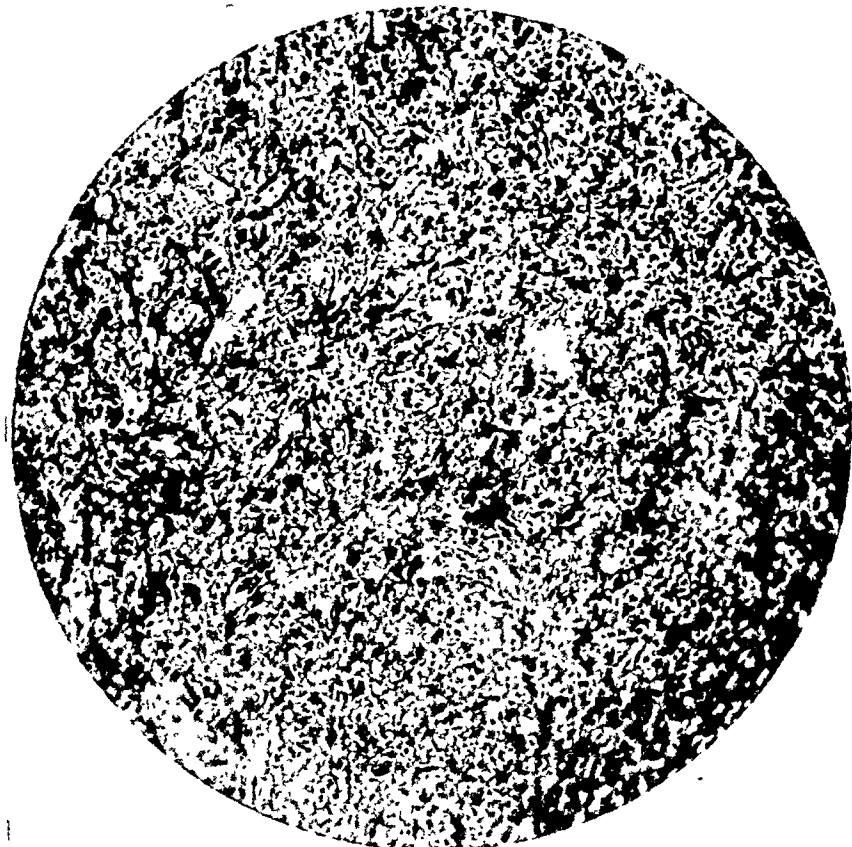


FIG. 3.—Section of spleen, showing round-cell infiltration and increase of connective tissue.

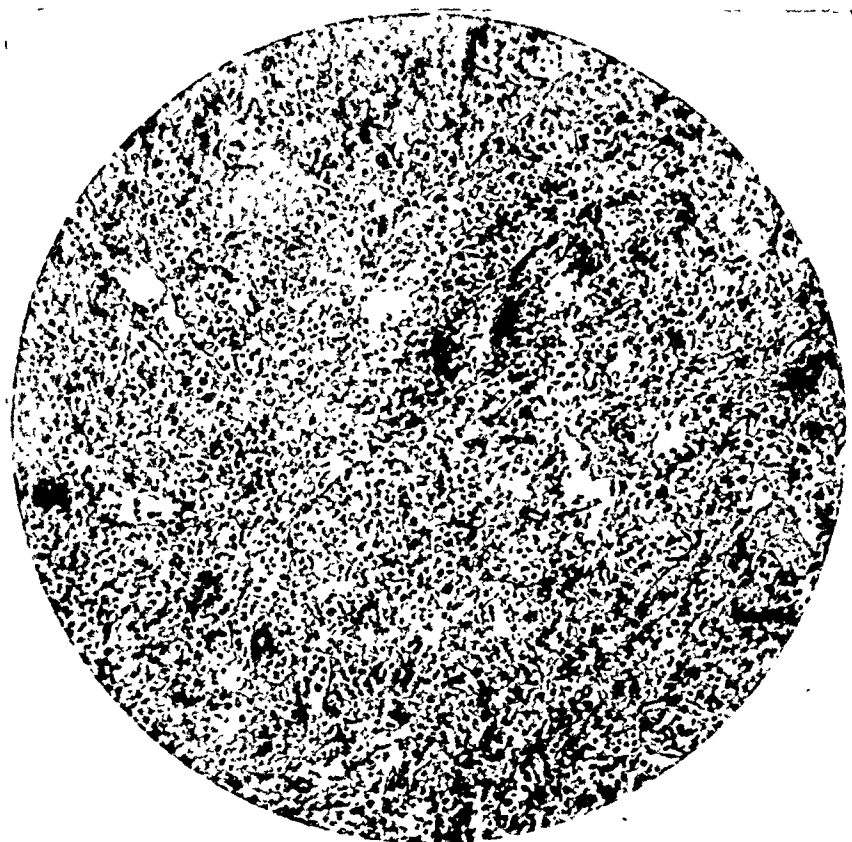


FIG. 4.—Section of spleen, showing round-cell infiltration.

## HEMORRHAGE INTO SPLEEN

colon, stomach, pancreas and diaphragm. Incision enlarged upward with resection of  $2\frac{1}{2}$  inches of eleventh and twelfth ribs for increased space. Spleen accidentally ruptured, allowing approximately 2000 c.c. of blood to escape. The spleen was delivered and pedicle clamped and ligated. The cavity mopped dry and packed with gauze strips. Weight of spleen three hours after removal, 1344 grammes, plus blood (estimated) 3344 grammes.

Unfortunately the hospital records covering the period between the time of operation and his death are not obtainable, but my recollection is that he did not suffer from surgical shock, his temperature did not run high and for three days his condition seemed favorable, but on the fourth day he showed signs of exhaustion, the symptoms becoming more pronounced, until death ensued on the fifth day from general exhaustion, superinduced by the prolonged period of pain and the starvation preceding his operation.

*Pathological Findings* (as reported by the Columbus Laboratories).—Sections made from spleen show that there is an increase in connective tissue and numerous round-cells (polymorphonuclear). There is no focal necrosis or other change. Our opinion is that this is splenitis simply. Eosinophilia and other special cells are absent.

It is of interest to note the changes in the blood picture for the five days between the time of operation and his death. Particularly the rapid fall in the white count and persistent polymorphonuclear leucocytosis.

Blood examination	First day	Second day	Third day	Fourth day	Fifth day
Hæmoglobin.....	.....	38 per cent.	36 per cent.	35 per cent.	40 per cent.
Red cells per cm....	.....	3,032,000	3,336,000	3,256,000	3,424,000
Red cells.....	.....	60 per cent.	66 per cent.	64 per cent.	68 per cent.
Corps. Hemo index.....	.....	.5	.4	.4	.4
White cells per cm..	158,000	150,400	118,000	106,400	100,000
Differential					
Polymorphonuclear.....	.....	60 per cent.	100 per cent.	88 per cent.	92 per cent.
Large mononuclear.....	.....	34 per cent.	.....	1 per cent.	4 per cent.
Small mononuclear.....	.....	6 per cent.	.....	11 per cent.	4 per cent.
Eosinophiles.....	.....	0	.....	0	0

If we accept the statement of Anders and Boston that in over 80 per cent. of all cases of splenitis the symptoms are indefinite or absent, we can reconcile ourselves to the belief that this was one of the 80 per cent. of symptomless cases in which the disease had insidiously affected the splenic artery until its walls became friable and so weak that the slight effort of pulling weeds ruptured the artery, and we had a rapidly

forming hæmatoma, the blood extravasating through the pulp with its subsequent pressure symptoms and enormous distention of the capsule and perisplenic adhesions.

This would be an easy and perhaps satisfactory explanation of the condition found, if we did not attempt going farther in our efforts to discover why he had splenitis in the first place. Here we confront a stone wall.

A reference to his history shows no past illnesses, excepting pyorrhœa three years before. We then have what appears to be a primary simple splenitis.

#### ANALYSIS OF FIVE CASES

*History of Trauma.*—In no case was there a history of any marked traumatism; in the author's case stooping over may have acted as a minimal traumatism.

*History of Infection.*—None.

*History of Pain, Shock, Etc.*—In three of the six cases there was pain at the onset—Di Bernardo's, Martyn's and the author's. In the last two it was severe, and led to fatally ending symptoms. Both Martyn and the author regarded their cases as examples of "hemorrhagic splenitis."

*History of Prolonged Splenomegaly.*—This was absent in the cases of Di Bernardo, Martyn and the author, and present in a high degree in the cases of Routier and Jordan (splenectomy having been done for mechanical reasons only).

Thus far in the analysis the cases of Routier and Jordan compare very well, and there are strong points of resemblance between the cases of Martyn, Di Bernardo and the author (all recently reported).

The cases of Routier and Jordan are examples of a latent hemorrhagic process of a highly diffuse character, in which the organ was almost destroyed. There was no symptomatology. Jordan's case seems to have been furthest advanced, as hardly any parenchyma remained. Enough was present in Routier's case to show that the process was focal in character, the smaller foci probably coalescing in the pole first attacked. Since small foci of hemorrhage may be seen in chronic splenitis, these cases might be termed chronic hemorrhagic splenitis.

There remain for comparison the three related cases of Martyn, Di Bernardo and the author. In none was there any suspicion of any serious trauma (mere stooping over in the author's case), nor any history of infection or splenomegaly. Sudden, severe pain ushered in the condition in spleens doubtless diseased but not known to be so.

## HEMORRHAGE INTO SPLEEN

After the initial symptoms evidences of an enlarging spleen were noted. In the cases of the author and Martyn the pain was not in the splenic region, but rather in the middle line. Di Bernardo's patient does not appear to have been a sick man, he had no complications. The entire (enlarged) spleen had been almost transformed within two months into a sac of bloody fluid, yet no rupture had been caused. This suggests a slow, gravescent type of bleeding. The author's case resembled the preceding in this respect, for only seventeen days after the onset of the disease, 2000 c.cm. of liquid blood were accidentally evacuated from the spleen. Martyn's case agreed with the author's in the severity of the symptoms and fatal termination. Both Martyn and the author looked upon their cases as examples of splenitis, but Martyn calls his case acute splenitis, a term hardly compatible with the findings. An acute septic abscess of the spleen may be accompanied with hemorrhage, but this case was not of that stamp.

As already stated, there are numerous reported cases which are comparable with the preceding in certain respects.

Two are very old cases incompletely reported. Sangalli describes a case of copious extravasation of blood in a hypertrophied spleen without any history of infection. The splenic tissue was permeated with small areas of capillary hemorrhage. Verga describes an autopsy case of fibrinous transformation of the enlarged spleen. Heurtaux describes a case of an enormous blood cyst in a woman of twenty-seven, following an injury eight years previously. Nine litres of thick altered blood were drawn off. The lesion, however, seemed to be a true cyst, and was readily cured by marsupialization and drainage. Similar cases could be cited. In this connection it must not be forgotten that profuse hemorrhage may occur secondarily in a cyst with serous contents.

A case which was originally thought to possess points of marked resemblance to the author's was that of Solieri. Solieri's case showed notable differences; there is a possibility that it represented a subcapsular rupture. This point is not made sufficiently clear. The patient, aged forty-eight, was an old malarial subject and had just experienced a two-day attack. Upon sneezing he at once experienced pain and shock, suggesting a sudden rupture. The symptoms disappeared but the spleen enlarged steadily for ten weeks. An exploratory incision revealed a spleen tense with blood, which was allowed to escape through a button-hole opening. The cavity was then closed. The author regards his case as an encysted hæmatoma.

The fact that the splenic tissue aside from the collection of blood was intact and that it was not necessary to extirpate the organ is sufficient to exclude this case from the group cited.

In regard to the real nature of intrasplenic hemorrhages, there are several causes which can account for part of them—as a central laceration, rupture of a diseased blood-vessel, hemorrhage into a pre-existing

cyst. None of these causes, however, can account for diffuse parenchymatous hemorrhage which is most readily explained by the view of a hemorrhagic splenitis, such as is known to occur at times on a relatively small scale. In a large number of sections of extirpated spleens at the Mayo Clinic we find mention of chronic splenitis with small foci of hemorrhage, and there seems to be no reason why this process may not occur on a larger scale. At the same clinic it is admitted that not a few enlarged spleens cannot be classified because of the total absence of any causal factors or associated lesions.

The term splenitis seems to have disappeared largely from the nomenclature. Acute splenitis, if it means anything at all, means a condition terminating in abscess, especially in general sepsis. It is said that septic splenitis of this sort may be hemorrhagic. Aside from this type, diffuse splenitis at its outset is usually termed tumefaction or congestion, and eventually there should be a small cell proliferation. Chronic splenitis has as a synonym fibrosis of the spleen, a condition due to metamorphosis of the new-formed connective tissue.

So great an authority as Baccelli does not apparently recognize simple splenitis as a cause of extravasation of blood. He holds that in a diseased spleen hemorrhage may occur from traumatism, while in non-traumatic cases the efficient cause is a varicose dilatation of the blood-vessels, such as occurs in typhoid and malarial spleens. Other authorities not quoted fail to mention such a condition as hemorrhagic splenitis. In the report of the author's case the pathologist found evidences of simple splenitis, while Martyn's case, termed acute hemorrhagic splenitis, was apparently an acute necrosis. As far as can be made out the spleen in Di Bernardo's case was the seat of a primary degenerative process, while in the remaining cases there is no reference to splenitis or necrosis, but normal splenic tissue was preserved in places. The very extent and long duration of these cases doubtless made it difficult to determine the exact nature of the morbid process involved.

The only conclusion we can reach is that extensive intrasplenic extravasations are very rare and not associated with any one special morbid process. No doubt in the past they have been regarded as false blood cysts, although the latter have almost invariably been reckoned as of traumatic origin, and in the vast majority of cases they have occurred in infected spleens. These two factors have been practically absent in the material we have analyzed. The slow and progressive as well as the diffuse character of the process is in evidence in several of the cases not only clinically, but pathologically.

## HEMORRHAGE INTO SPLEEN

The author has studied a number of recently reported cases of external rupture of the spleen in the hope of finding some basic resemblance to the cases detailed in the paper. In the traumatic cases violence was always marked and often extreme, while spontaneous ruptures practically always occurred in the presence of severe infections.

In conclusion the author acknowledges the assistance of Dr. Edward Preble, of New York City, in collecting the references and arranging the material for the paper.

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# CHOLEDOCHUS CYST

REPORT OF A CASE WITH REFERENCES TO THE LITERATURE

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IDIOPATHIC choledochus cyst is an extremely rare anomaly of the common bile-duct. Langenbuch, up to 1897, was able to find but a single case, that of Konitzky. Lavenson, in 1909, collected 28 cases of cysts of the common bile-duct. These included cases other than those of the idiopathic variety. Schloessman, in 1911, collected 16 cases which he considered represented all the cases of idiopathic choledochus cyst in the literature up to that time. Kehr, in 1915, after a careful study of the literature, places the number of idiopathic choledochus cysts at 19, including Konitzky's case. Kehr, himself, in his extensive experience had not observed a single case.

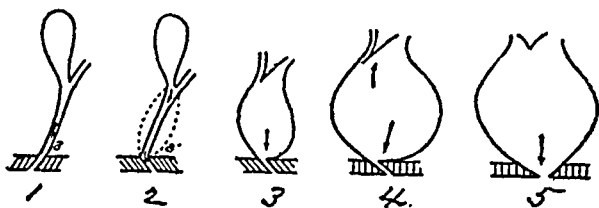


FIG. 1.—Rostowzew's explanation of the formation of choledochus cyst.

Idiopathic choledochus cyst is not to be confused with enlargement of the choledochus due to stone or tumor. Langenbuch, who was the first to direct attention to this condition of idiopathic choledochus cyst, was familiar with cases in which the common duct was enormously enlarged from obstruction, and differentiated Konitzky's case therefrom.

The cases of so-called idiopathic choledochus cyst are congenital anomalies. The enlargement is most marked in the middle and upper portion of the common duct. Rostowzew gives a plausible explanation of their occurrence. This is shown in the accompanying line drawings. In Fig. 1 is shown the normal course of the common bile-duct following a practically straight course through the duodenal wall; in Fig. 1, 2, the course of the duct in its passage through the wall of the duodenum is changed so that the duodenal portion is at an angle with the portion of the duct extraduodenal. The interference with the *direct* flow of bile



FIG. 2 —Choledochus cyst.





## CHOLEDOCHUS CYST

into the duodenum results, according to Rostowzew, in an enlargement of the common duct, as shown in Fig. 1, 3, 4 and 5. This explanation, while plausible, does not meet all the requirements of the anomalous condition. To the writer's mind the condition is one of congenital malformation. This view coincides with all the anatomical data at hand.

G. H., No. 33,366. A. C., male, aged twenty-two. Admitted December 2, 1915.

Operation, December 7, 1915, cholecystectomy, choledochotomy.

*Chief Complaint.*—Pain in epigastrium extending along the lower border of the ribs on the right side to the back; nausea but no vomiting.

*Present Illness.*—Began November 25, after breakfast, when patient complained of severe cramps in the epigastrium; cold sweat, nausea. A physician was called and gave a hypodermic injection which relieved the pain. The following day there was a similar attack, but more severe; the area of pain at this attack was at the tip of the tenth rib and radiated to the back just to the right of the vertebral column. It felt as if a knife was sticking in his back. When he took medicine (sedative?) the pain subsided. The next day he had a similar attack but less severe and accompanied by soreness in the back. From this time to the time of operation there were many slight attacks of pain in the epigastrium, stabbing in character and radiating to the back. There was loss of appetite and constipation. People told him he looked yellow during these attacks, and the stools were clay colored.

*Examination.*—The abdomen was somewhat rigid and distended; there was tenderness over the gall-bladder region and slight tenderness to the right of the vertebral column, just below the rib border; slight fever.

*Diagnosis.*—Cholecystitis acute. Cholangitis.

*Operation* (December 7, 1915).—High right rectus incision; there was no large intestine on the right side of the abdomen. The large intestine was down in the pelvis. The mesentery of the large intestine seemed to originate below the mesentery of the small intestine. The gall-bladder was enlarged and slightly thickened; no external evidence of acute inflammation. No gall-stones found; the cystic duct was enlarged and tortuous. The common duct was dilated to the size of a large orange and had the appearance of a cyst (Fig. 2). Evidence of chronic pancreatitis was present (areas of old fat necrosis). The appendix was removed in the usual manner. The gall-bladder was removed. So enormous was

the dilatation of the common duct that the possibility of an echinococcus cyst was thought of. A hypodermic needle was introduced into the duct and clear bile withdrawn. The duct was then opened. Its walls were very thin. There was an immediate escape of clear bile. The opening in the duct was enlarged sufficiently to admit the finger. Digital examination disclosed a smooth-walled cavity with four openings; two above, which were undoubtedly the hepatic duct openings; one laterally, the cystic duct opening; one below, the opening of the common duct into the duodenum. This latter was large enough to admit the tip of the examining finger into the duodenum; the other openings were somewhat smaller. All the openings were firmly resistant to further dilatation. The common duct was drained by a small rubber tube fastened with a purse-string of plain catgut. A split tube drain was placed in the foramen of Winslow.

*Pathological Examination.*—Macroscopic: the gall-bladder was somewhat enlarged, the walls thickened, the cystic duct enlarged, thickened and tortuous and entered the gall-bladder at a more acute angle than usual. The mucous membrane was thickened, the epithelium lacking in places. Microscopic diagnosis, *cholecystitis chronica*. Culture from the common duct negative.

*After Course.*—There was very little fever; three days after operation the temperature was normal. Pulse went up to 130 after operation and gradually came down to normal on the fourth day; after that it varied between normal and 100. Respiration remained normal throughout. Patient had slight pain, vomited once or twice during the first few days after operation. There was quite a little bloody discharge for two or three days from the split tube drain and wound. A week after operation pulse, temperature and respiration were practically normal; pulse of fair quality. There was bile drainage through the tube; no complaint of pain. A blood clot formed in the wound and became infected. After cleansing the wound was united by secondary suture. The second week patient began to complain of slight pain in the wound region and there was increased drainage of bile through the tube. Practically all the bile escaped externally. This was strained and injected by rectal tube in the colon, where it was moderately well tolerated. The stools were clay colored throughout. From this time on the patient began to lose strength slowly. On the twelfth day a perirectal abscess was incised. There was occasional vomiting. Cardiac stimulation became necessary. In spite of all efforts the patient gradually lost weight and strength; his pulse became very weak and gradually imperceptible until De-

## CHOLEDOCHUS CYST

ember 29, 1915, when he died of asthenia. For twelve hours before death there was no escape of bile from the wound.

Autopsy was refused.

*Remarks.*—This condition is so rare that it perhaps is idle to discuss the possibility of cure. Most of these cases die in childhood from cholangitis; the dilated duodenal opening predisposing to early infection. Should another case present, however, I would resect as much of the common duct as possible in an attempt to reduce the duct to approximately normal size; although owing to the anatomical anomaly present at the opening of the duct into the duodenal, it is quite improbable that such an attempt would be successful.

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## RETROPERITONEAL RUPTURE OF THE DUODENUM BY BLUNT FORCE

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RUPTURE of the gastro-intestinal tract produced by the action of blunt force with little or no injury of the abdominal wall is one of the most interesting subjects in the whole field of traumatic surgery. We have now systematic knowledge of this whole group of cases and it is very generally agreed that such injuries are produced almost always by one of three methods, namely, crushing of the bowel between the force which is acting and the spine, bursting by increasing internal pressure within a loop whose ends are momentarily closed, and, finally, tearing of the bowel at a point of juncture between a fixed and a relatively free sector of the gut. There are, of course, other unusual methods of production which are matters largely of academic interest. Bowlby (*British Journal of Surgery*, 1916, vol. iii, No. 11, p. 463) has recently described what appeared to be a rupture of the bowel due to the air pressure exerted by a high velocity bullet traversing the abdominal wall and not entering the peritoneal cavity.

In the study of the general subject of subcutaneous rupture of the bowel, comparatively little attention has been paid to the peculiar features of rupture of the duodenum, although this lesion forms apparently about 10 per cent. of the total material. This seems a surprisingly high percentage, and yet of the 132 cases reported by Berry and Guiseppi (*Proc. Royal. Soc. Medicine*, 1909, vol. ii, Surg. Section, 1-66), a series which includes all cases occurring in ten London hospitals between 1893 and 1907, 18 per cent. of the total number are ruptures of the duodenum. Still less attention has been paid to the quite characteristic features presented by retroperitoneal rupture of the duodenum, although from 25 per cent. (Berry and Guiseppi) to 33 per cent. (Schumacher, *Beitrage zur Klinischen Chirurgie*, 1910, Bd. 71, p. 482) of all traumatic duodenal ruptures due to blunt force are retroperitoneal and do not communicate with the peritoneal cavity as a primary effect of the original injury. This particular lesion apparently has a mortality of about 90 per cent. as contrasted with the estimated mortality of subcutaneous bowel rupture in general of 70 per cent.; although mortality figures in this general group of cases are of

## RETROPERITONEAL RUPTURE OF THE DUODENUM

doubtful value, since mortality varies rather directly with the length of time intervening between injury and operative interference, nevertheless, a comparison of the various statistical tables presented in the literature shows a consistently higher mortality for subcutaneous retroperitoneal rupture of the duodenum than for blunt force rupture of the gastro-intestinal tract in general. The rather sparse literature dealing with the topic under discussion evidences our failure to appreciate the frequency of this lesion and its extremely fatal effect. One ex-

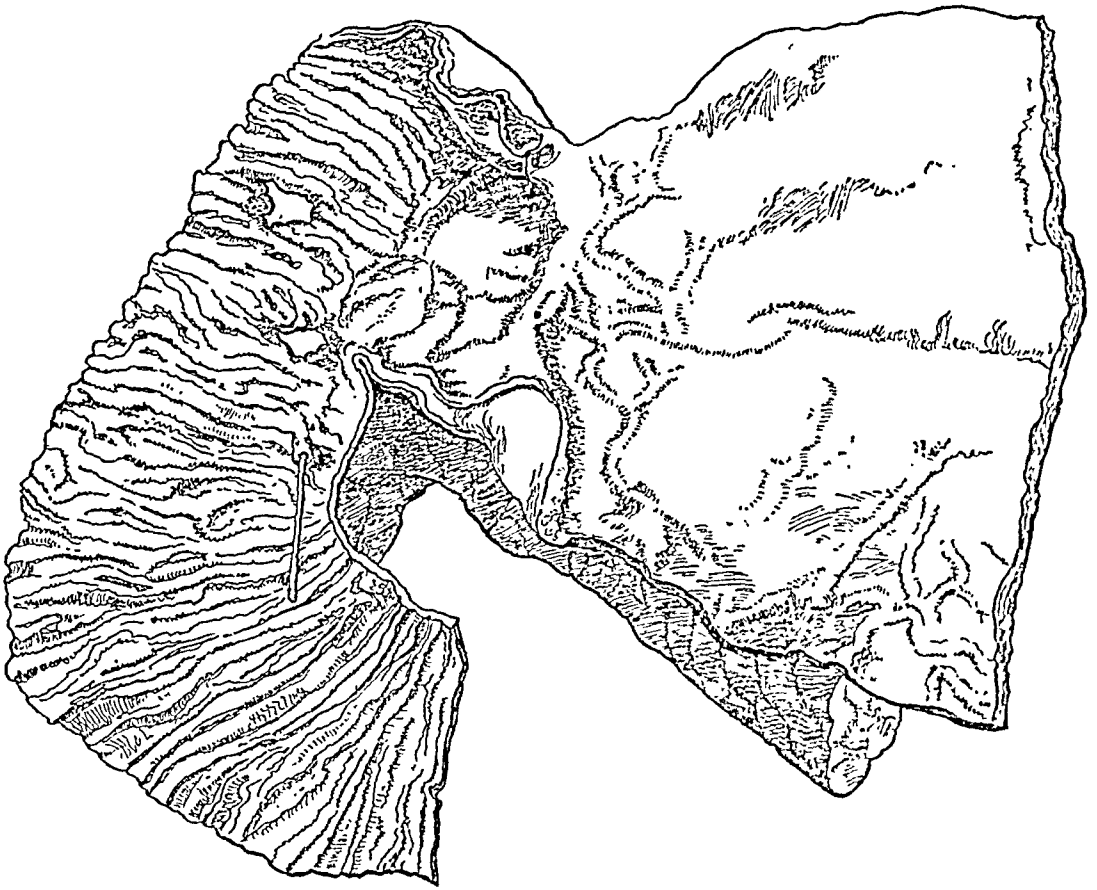


FIG. 1.—Double traumatic retroperitoneal rupture of the second portion of the duodenum. The pyloric portion of the stomach and the duodenum have been opened, showing the appearance of the ruptures on the mucosal surface. The sizes of the ruptures are somewhat exaggerated in the drawing. Note the proximity to the papilla of Vater.

planation of the high mortality rate is the obscurity of the lesion. With intraperitoneal rupture of the bowel, it is seldom difficult to find the lesion promptly after the abdomen has been opened. This is not true, however, of retroperitoneal rupture of the duodenum; in a series of 37 reported operations, the lesion was missed 13 times, or in approximately one-third of the cases, although the laparotomies were made by competent surgeons and with the probable diagnosis in mind. In contrast

to this is the fact that subcutaneous retroperitoneal duodenal rupture produces a striking and constant pathological change which is easily found and just as easily interpreted during the course of the operation. The operative findings are practically pathognomonic. In view of the above facts, it seems worth while to report a personal case and to present the result of the study of the literature. The following report is based upon a series of 22 cases, occurring since 1910, the date of the appearance of an article by Schumacher, who reviewed very thoroughly the subject up to that time, reporting a series of 24 cases; there are thus available practically 50 cases, from whose study definite knowledge is to be gained.

**CASE REPORT.**—Retroperitoneal rupture of the duodenum by blunt force. Operation on the tenth day. Death within fifty hours after operation. Autopsy.

J. L., male, aged twenty-one, miner, admitted October 26, 1915. Hospital No. 2567. Previous history unimportant.

*Present Illness.*—Three days ago the patient was kicked by a mule, whose hoof struck him in the right upper quadrant of the abdomen and in the right flank. The blow did not knock him down, though a little later he fell to the ground; he was picked up and taken home. During the remainder of the day the patient had no severe pain and sat up in a chair at intervals. After an unstated period he began to complain of pain over the entire abdomen, definitely cramp-like in character. He has taken small amounts of water since the accident, but with the onset of pain became nauseated and has vomited several times. The patient has voided normally and there is no history of blood in the urine. Last night the patient was unable to sleep soundly because of abdominal pain, and he was brought to the hospital this morning, since his condition did not seem to be improving. His friends volunteer the information that the mule was a rather decrepid animal and, they seem to think, quite unable to kick hard enough to cause much damage; in this and other ways, they minimize the severity of the accident, insisting that the patient's discomfort has been, even up to the present time, so slight as to be of no great moment. They seek aid because "he did not seem to be doing well," rather than because of pain.

*Examination.*—Patient is a well-nourished man, apparently not in great pain. Facial expression is not that of an acutely ill person. Pulse 80 to the minute, regular and full. Temperature per rectum 101°. Respirations regular, 32 to the minute. Leucocytes 5100. Chest negative.

## RETROPERITONEAL RUPTURE OF THE DUODENUM

Abdomen: No external evidence of injury. Moderate general symmetrical distention. Abdominal respiratory movements decreased, especially on the right side, where deep inspiration causes much pain. No masses or visible peristalsis. On palpation, slight general tenderness and very slight muscle spasm, more marked on right side than on left and maximum in the right upper quadrant. Definite tenderness in the right flank and quite acute tenderness below the right twelfth rib in the back. On percussion, impairment of the note in the right lower quadrant extending into the right flank. Liver dulness present. Rectal examination negative. No evidence of bony deformity.

*Impression:* The patient does not seem ill and is not in great pain. The abdominal examination is quite comparable to that seen in simple abdominal contusion. The pulse is normal and the leucocytes are even subnormal. The patient was put to bed for observation.

Nine hours subsequently there was no change in the patient's condition other than the fact that the temperature by rectum reached 102.6°. Bowels moved well after an enema. The lesion was not considered a progressive one and accordingly the patient was treated expectantly.

October 27, 1915: Condition apparently much improved. There is very slight distention and there is no tenderness except in the right upper quadrant and in the back, where it is very much less than yesterday. Temperature 100°; pulse 84. The patient volunteers the information that he feels much better.

November 3, 1915: During the past seven days the temperature has shown a gradual fall, being usually about 99° or less, though reaching 101° on October 29, four days ago. The leucocytes have never been above 8000 on daily counts. He has been taking liquid nourishment in limited amounts and until this morning seemed to be improving. Last night the patient vomited and again this morning. There is definite visible peristalsis from left to right in the upper abdomen. The expression is not so good. Operation advised, in the presence of a normal leucocyte count, normal pulse-rate and a practically normal temperature.

*Operation* (November 3, 1915).—Exploratory laparotomy. Findings: retroperitoneal perforation in the second portion of the duodenum with localized retroperitoneal abscess. Patient stood operation poorly, hence impossible to attempt closure by suture. Drainage.

With the patient in surgical anaesthesia, there became evident for the first time a fixed mass occupying the greater portion of the right upper quadrant. High right rectus incision. The peritoneal cav-



ity was quite clean throughout and contained little or no free fluid. In the right upper quadrant, there were extensive recent adhesions between the liver and the adjoining viscera. After the general peritoneal cavity had been packed off, these adhesions were broken



FIG. 2.—The specimen as seen from the posterior aspect. The retroperitoneal portion of the duodenum is deeply shaded and the ruptures are seen to be entirely in this area.

up. The liver was found uninjured. Proceeding further, there was opened a retroperitoneal abscess lying behind the first and second portions of the duodenum and apparently well localized; from this abscess there was evacuated about 6 ounces of bile-

## RETROPERITONEAL RUPTURE OF THE DUODENUM

stained, foul-smelling pus. Further investigation disclosed a perforation on the posterior aspect of the superior half of the second portion of the duodenum. The perforation just admitted the finger tip. With the limited mobilization of the duodenum allowed by the adhesions, the perforation was quite inaccessible to suture. Gastro-enterostomy, though diverting the gastric contents from the injured area, would in no way prevent the escape of pancreatic secretion and bile and was therefore not indicated. The patient's condition became quite urgent and for this reason we were forced to content ourselves with free drainage only. The prognosis seemed exceedingly bad.

November 5, 1915: The patient died about fifty hours after operation, having during this time failed to improve in any way. There was a very free discharge from the wound.

*Autopsy.*—There was a general plastic exudate throughout the peritoneal cavity. In the pelvis there was a small amount of yellowish purulent exudate. The appendix was negative. The duodenum showed two perforations; the first, measuring 1.5 cm. in diameter, was situated on the retroperitoneal aspect of the second portion of the duodenum, 2 cm. above the papilla of Vater, and the second perforation, 1 cm. in diameter, was also in a retroperitoneal position, 1 cm. above the papilla of Vater. The perforations had clean edges with pouting margins and showed no evidence of sloughing. The adjacent intestinal wall was healthy. The papilla of Vater was uninjured. All the retroperitoneal tissues of the right flank from the duodenum downward to the brim of the pelvis were of a dark red color, soft, spongy and bathed in brownish pus. About the right kidney, this retroperitoneal cellulitis was particularly marked. The remaining facts discovered at autopsy were of no particular significance other than as showing a moderate degree of general systemic reaction to infection.

In considering this case, one is struck by the contrast between the relatively slight accident and deceptive condition of the patient and the fatal type of injury produced. At autopsy, the appearance of the ruptures made it quite evident that they had been produced at the time of the accident and were not the result of secondary necrosis in the bruised duodenal wall; the patient had been developing a large retroperitoneal abscess during the period of ten days intervening between injury and operation, though during this time his leucocytes were not above normal, his pulse-rate was not above normal and his temperature showed only moderate variation from the normal. The abdominal signs during this period were correspondingly negative and the patient's statement of his own condition was always to the effect that he "felt better." Operation was finally made on the tenth day after injury because the patient vomited twice in rather large amounts, second, be-

cause a short time before operation, he showed marked visible peristalsis in the upper abdomen from the left to the right and certainly in the stomach wall, and, finally, because of the sudden and rapid change of facial expression. The slight general and local reaction during the formation of the retroperitoneal abscess may possibly be explained in part by the relative sterility of extravasated duodenal contents. One of the chief indications for interference we had was definite evidence of obstruction in the region of the pylorus; operation disclosed the second portion of the duodenum compressed to the point of complete occlusion between a massive abscess behind and the tensely stretched peritoneum in front. This sign, though diagnostic in our case, is of little practical importance, since it can develop only late and, hence, at a time when any treatment would be probably without avail. In general, the case varied only slightly from the picture so frequently seen in abdominal contusion without intraperitoneal injury, and in reviewing the case, the author has the feeling that this patient could have been rescued only by following a rule of invariable operation on the slightest suspicion of intra-abdominal injury. This, of course, is one lesson to be learned from the study of subcutaneous rupture of the bowel in general, but it is only by the exercise of the keenest diagnostic discrimination that one can possibly avoid exploring many negative cases. One other point of interest is the presence of tenderness beneath the right twelfth rib. This was present in only one other case of my series, which seems curious, since with right-sided subphrenic abscess this sign is fairly constant. Careful observation with reference to this point should help in diagnosis.

In 1910, Schumacher reported a case of retroperitoneal rupture of the duodenum and presented a review of the subject up to that time, incorporating the work of Jeannel (*Archives Prov.*, 1899, Nos. 7, 8 and 9) and Meerwein (*Beitrag zur Klinischen Chirurgie*, 1907, Bd. 53, p. 496) in his report. He collected 91 cases of rupture of the duodenum by blunt force, in 24 of which the rupture was retroperitoneal. In the literature since his time, there are found 22 typical cases of retroperitoneal rupture of the duodenum. I have made no attempt to collect all cases of rupture of the duodenum, but have selected only those in which the primary force produced a rupture of the duodenum, which communicated in no demonstrable way with the peritoneal cavity. One case was found in which there was an associated primary tear of the overlying peritoneum without a resultant peritonitis (Group II) and two cases of partial retroperitoneal rupture were encountered (Group IV). Three additional cases were found, in 2 of which a

## RETROPERITONEAL RUPTURE OF THE DUODENUM

second simultaneous rupture of the duodenum communicated with the peritoneal cavity and, in the third, one rupture involved both the retro- and intraperitoneal surfaces of the duodenum.

The study herewith presented is based thus on 28 cases, but the major part dealing with the characteristic clinical and pathological features of retroperitoneal rupture is based on the 22 typical cases in my series and Schumacher's 24 cases.

This injury is almost peculiar to the male during his active working years. Twenty-four of the cases were in men, the average age being about twenty-four years, 13 of the cases occurring before or during the twentieth year.

The accident sustained does not differ materially from that found in subcutaneous ruptures in general. Of the 22 cases, 7 were crushed between a heavy fixed and a heavy moving object, usually a wall and a wagon, 7 were struck on the abdomen by a blunt object, such as a rake handle, a board, a heavy piece of iron, etc., 6 were run over, 6 were kicked, notable in this group being 2 in which the injury was caused during a foot-ball game by the patient receiving a kick from a "player's knee"; in one instance, the lesion was produced by a fall on a fixed object and in another by a horse falling on the patient. The etiology seems to vary markedly with different series; for instance, in Berry and Guiseppi's 132 cases of subcutaneous rupture of the bowel there were 51 cases in which the injury was caused by the patient being run over. Although the kick of a horse figures heavily in most of the reported groups, nevertheless, the military surgeons tell us that only a few such accidents result in rupture of the bowel; Pech (quoted from Berry and Guiseppi) states that of 71 cases of abdominal injuries from horse kicks and occurring at one of the foreign barracks in twenty years, 69 recovered without operation and 2 died from rupture of the bowel. Rupture of the duodenum is especially frequent in blows received in the upper abdomen or directed toward the upper, though received in the lower abdomen.

*Situation and Character of the Rupture.*—Of the 22 cases studied, in 18, or 82 per cent., the rupture was situated in the second or third part of the duodenum. In Schumacher's 22 cases, all of the ruptures were situated in the second or third portions of the duodenum. The lesion produced is usually "punctate" in character (8 cases), though a large number of them are circumferential (6 cases) and only the odd case has a rupture parallel to the long axis of the bowel (1 case). The punctate lesion varies in size up to  $4\frac{1}{2}$  cm. in diameter and usually has clean-cut edges with everted mucosa. Necrosis of the adjacent bowel

wall is uncommon, from which one can reasonably infer that these punctate lesions are produced at the time of the accident and are not the result of secondary sloughing. Of the 6 circumferential tears, but 2 caused complete division (in parts 3 and 4); this type of tear usually extends one-half or two-thirds of the way around the bowel, leaving a strip of undivided bowel wall. There occurred 2 cases in which the duodenum showed two discrete retroperitoneal ruptures (Cope, *Proc. Royal Soc. Med.*, London, 1913-1914, vol. vii, Surg. Section, 86-107, and the author's case); both cases involved only the second portion of the duodenum. In Group III, there was found 1 case in which there had occurred two simultaneous punctate ruptures, one on the posterior wall and one on the anterior wall, the lesions being directly opposite each other (Quenu and Matthieu, *Bull. et mem. Soc. de Chir. de Paris*, 1912, n.s. xxxviii, p. 234). It is interesting to note that in Schumacher's 22 cases, there occurred but 2 cases of double rupture.

*Operative Findings.*—Of the 22 cases, 16 are described more or less accurately with reference to operative findings. Thirteen of these showed at operation either a retroperitoneal hæmatoma or a retroperitoneal extravasation, and of the remaining 3 cases at least 2, from the description given, must have had similar findings. This hemorrhage, or extravasation, or a combination of the two occupies a perfectly characteristic position, namely, it is always found either in the root of the transverse mesocolon, in the root of the mesentery of the small bowel, or involving both of these structures and the intervening retroperitoneal space, very frequently extending somewhat to the right over the kidney. The tumor is usually crepitant, since it contains gas and appears quite dark when the blood is in excess or of a rather light grayish color, shimmering through the overlying peritoneum, when extravasation and suppuration dominate. The extravasation after the receipt of the injury is usually rapid; in 1 case (Helfrich, reference from Schumacher), the operator observed the actual spread of the escaping gas in the mesocolon and thus into the wall of the ascending colon, a fact which led him to a diagnosis of traumatic perforation of the bowel. The content of this swelling when incised shortly after the receipt of injury is variously bloody, bile-stained, or darkish colored fluid, mixed with gas; it soon becomes purulent and of foul odor, while in a few cases the adjoining tissues are black and gangrenous, this latter finding probably owing to associated injury to the pancreas. When exposed within a reasonably brief time after the receipt of injury, the extravasation or hemorrhage is usually limited to the outlines mentioned above; as time elapses, it spreads rapidly. The peritoneal cavity commonly

## RETROPERITONEAL RUPTURE OF THE DUODENUM

contains a certain amount of free fluid, usually described as blood-stained and in a few instances as bile-stained. The source of this blood is usually not discovered; inasmuch as the posterior peritoneum is intact, it probably comes from an associated minor rupture of liver or some adjacent viscus. In perfectly characteristic cases, there are found multiple petechial subperitoneal hemorrhages scattered over the transverse mesocolon, the ascending and transverse colon, the omentum and the mesentery. Winiwarter (*Deutsche Zeitschrift für Chirurgie*, 1912, vol. cxiii, p. 582) has drawn attention to this appearance and described it as typical. Fat necrosis was observed in but 3 cases, scattered over the hepatic flexure, the transverse colon, the transverse mesocolon and the omentum. In but one of these cases was the pancreas possibly involved grossly in the original injury. The intimate anatomical association between the duodenum and the pancreas would lead one to suppose that violent injury of the duodenum would be rather constantly associated with primary gross lesion of the pancreas, but autopsy records do not bear this out. Two cases showed marked dilatation of the stomach and transverse colon (Nos. 13 and 22); 2 cases showed laceration of the mesentery at time of operation (Nos. 11 and 18). When operation is made within a reasonably short time after injury, say within the first forty-eight hours, the above findings are constant and the peritoneal cavity itself is clean. It is true that there is commonly found a little fluid in the peritoneal cavity, and perhaps in a strict bacteriological sense, one would not be justified in regarding the peritoneum as sterile, nevertheless, there is practically never found, at reasonably early operation, a peritoneal cavity which is acutely inflamed in the sense that there is evident serofibrinous exudate. This fact is very striking and is of great importance.

Given a case of blunt force violence in the upper abdomen, resulting in symptoms which lead one to explore the peritoneal cavity, the typical findings, with retroperitoneal rupture of the duodenum, are a clean peritoneal cavity with a little free blood-stained fluid, a hemorrhagic crepitant swelling in the root of the transverse mesocolon extending over the right kidney and down into the root of the mesentery, petechial subperitoneal hemorrhages and possibly fat necrosis in the transverse mesocolon, the ascending and transverse colon and the mesentery. These findings are, in the main, constant in the 16 accurately described cases of the 22 studied. It is virtually pathognomonic to find such a swelling behind a clean peritoneal cavity. Surely so typical a picture should lead one to immediate diagnosis, and yet of the 21 cases operated upon, the rupture was missed 8 times, although laparotomy was under-

taken because of probable rupture of the bowel. It seems certain that had the surgeons been familiar with the very definite operative findings, none of these 8 cases would have been closed without the rupture being found. In Schumacher's group of 16 cases submitted to operation, the rupture was missed 6 times, although diligently searched for. The

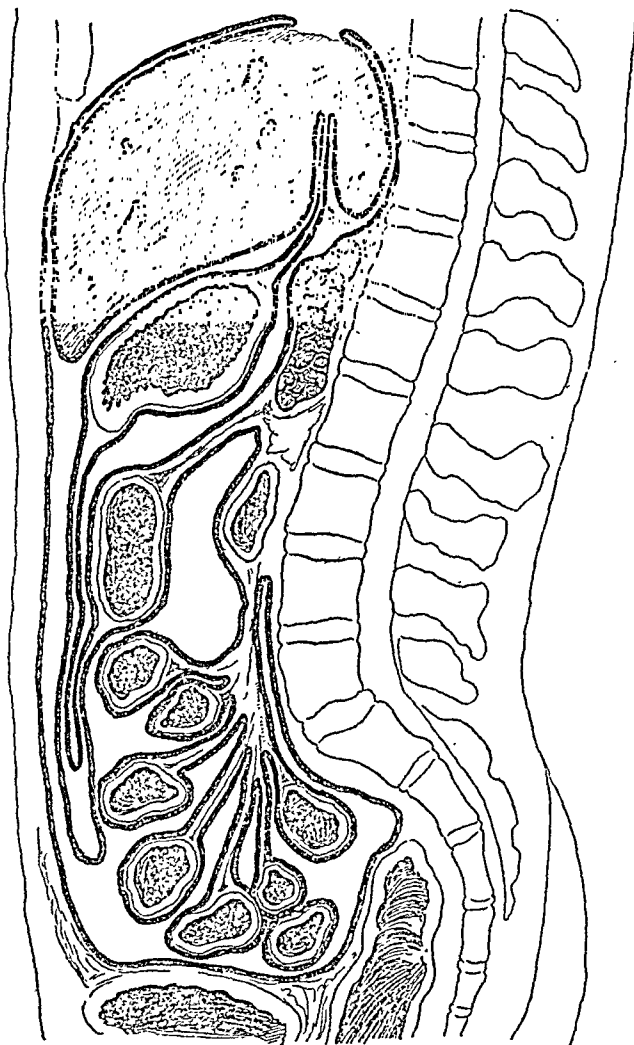


FIG. 3.—Schematic sagittal section of the abdominal cavity in the midline, showing the cross-section of the third portion of the duodenum and the relationship to the root of the transverse mesocolon and the root of the mesentery. (Adapted from Spalteholz.)

large proportion of cases in which the rupture was missed at operation is particularly striking, when one remembers that the cases were in the hands of thoroughly trained abdominal surgeons.

*Spread of Extravasation.*—The occurrence of retroperitoneal extravasation is constant, there being but one exception that I have encoun-

## RETROPERITONEAL RUPTURE OF THE DUODENUM

tered, namely, the case of Thompson (Schumacher's reference), in which the rupture was plugged by clotted blood. Figs. 3 and 4 give a very good idea of the relations existing between the second part of the duodenum and the root of the transverse mesocolon as against those between the third part of the duodenum and the root of the mesentery; this relationship would lead one to expect rupture of the second part to result in extravasation primarily into the transverse mesocolon, and rupture of the third part into the root of the mesentery. Such a relationship, however, has not been described in the recorded cases. The extravasation makes its appearance in the region of the root of the transverse mesocolon, spreading from this point out over the right kidney and downward into the root of the mesentery; in its further

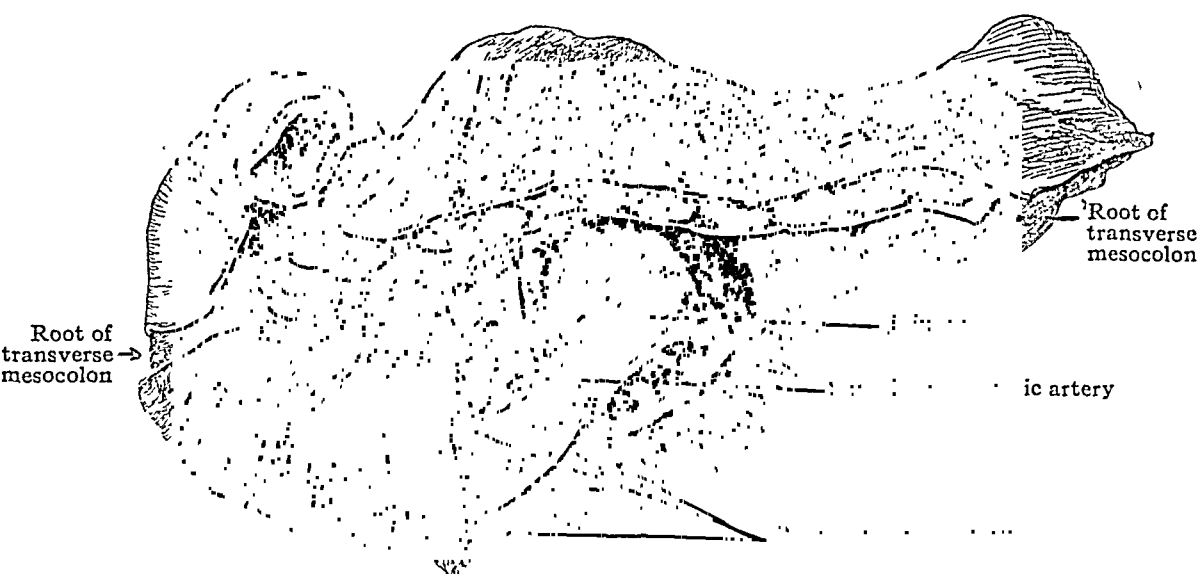


FIG. 4.—Duodenum and pancreas, viewed from in front. A piece of the first portion of the duodenum has been cut off. The peritoneum has been cut away exactly at the point where it turns away from the duodenum and pancreas. (Adapted from Spalteholz.)

progress it follows down behind the ascending colon even extending perhaps into the pelvis. In extreme cases, it may cross to the left side, involving virtually the entire retroperitoneal space. Rarely, the extravasation may point in the region of Poupart's ligament (Petren, *ANNALS OF SURGERY*, 1915, vol. lxi, p. 414). While the extent of the extravasation as outlined above is almost constant, it is not invariably present; Maddock (*British Medical Journal*, 1914, p. 852) reports a case in which the suppurative process travelled laterally along the ribs, producing an abscess in the right lobe of the liver and pointing low in the axilla. Keller (*Beitrage zur Klinischen Chirurgie*, 1914, vol. xc, p. 451) reports a case in which there was, in addition to widespread retro-



peritoneal extravasation, purulent mediastinitis and pleurisy. Retroperitoneal extravasation from a duodenal leak may travel upward along the great vessels and thus gain access to the mediastinum; however, progress by this route is rare and usually associated with a slow leak of the duodenum, such as occurs in subacute perforating ulcers of the posterior wall. Petren has made a very interesting report on this subject.

*Peritonitis.*—There has been more or less discussion as to how much protection against the rapid onset of peritonitis is given a patient by the fact that the rupture is entirely retroperitoneal and does not leak into the peritoneal cavity. The opinion has even been expressed that peritonitis follows just as certainly and just as quickly after retroperitoneal rupture of the duodenum as after intraperitoneal rupture; a study of the reported cases does not bear this out. Peritonitis, undoubtedly, will follow in most cases unless operation is made promptly; there is, however, a very definite delay in its appearance due to the protection afforded by the intact posterior peritoneum. Any type of retroperitoneal suppuration, if neglected, may and probably will result in peritonitis. This question, however, is largely a matter of academic interest, since there can hardly be a great difference between the mortality of widespread retroperitoneal suppuration and that of generalized peritonitis, the one being quite as fatal as the other. The essential thing is to recognize the presence of a leak in the gastro-intestinal tract promptly; unless this is done, retroperitoneal suppuration inevitably follows and later a general peritonitis as well, either of which is usually fatal.

The extravasation early in a typical case may occur so rapidly and yet be so well localized as to produce a fixed tumor in the right upper quadrant of the abdomen. Enderlen (Meerwein, *loc. cit.*) observed such a tumor after an abdominal traumatism and made the mistaken diagnosis of intraperitoneal hæmatoma. Berry and Guiseppi's first case showed, twenty hours after accident, a fixed tumor in the right upper quadrant, dull on percussion and continuous with the liver; since the patient had not the appearance of internal hemorrhage, a diagnosis of retroperitoneal rupture of the duodenum was made and confirmed at autopsy, no operation being undertaken. This is the only instance encountered of correct diagnosis. My own case showed a quite similar tumor discovered, however, only just before the abdomen was opened. Had I been familiar with this injury and its effects the finding of such a tumor should have led to a diagnosis.

## RETROPERITONEAL RUPTURE OF THE DUODENUM

*Operative Results.*—Of the 22 cases reported, laparotomy was made 20 times and in 1 case a retroperitoneal abscess was opened low in the axilla. Of the 21 cases operated upon, but 3 recovered. No case survived when operation was postponed more than twenty-four hours; however, of the 10 cases operated upon within the first twenty-four hours, 3 recovered. Winiwarter, *loc. cit.* (Case No. 6), successfully sutured a traumatic subperitoneal rupture of the anterior wall of the third portion of the duodenum nine hours after the accident. In Wrede's (*Munch. med. Woch.*, 1914, vol. lxi, p. 846) successful case (No. 13), operated upon twenty hours after injury, the operator resected 2 inches of the third portion of the duodenum, closing both ends and making a retrocolic duodenojejunostomy. Niederle (Case No. 21) (*Cosop, lek. cesk., V. Prase*, 1915, vol. liv, pp. 31-36) successfully operated upon a case four hours after the accident, making a simple two-layer suture of a rupture at the junction of the second and third portions of the duodenum and a posterior gastro-enterostomy. Schumacher reports among 24 cases but 2 (Enderlen and Helfrich) in which operation was successful. Seven hours after injury, Enderlen (reported by Meerwein) resected the duodenum from just below the papilla to the duodenojejunal juncture, closed the ends, made a posterior gastro-enterostomy, and, the patient still being in good condition, anastomosed the first portion of the duodenum to the upper jejunum to provide exit for the bile and pancreatic juice; the patient recovered. Helfrich (reported by Hamann, *Ein Fall von Ruptur des Duodenums durch Hufschlag. Dissertation. Kiel*, 1907) made a successful suture of a rupture in the second portion of the duodenum; a duodenal fistula which developed after operation closed spontaneously. Thus among 45 reported cases of operation for retroperitoneal rupture of the duodenum, there are but 5 recoveries, a mortality of 89 per cent. There are a few cases of combined intra- and extraperitoneal rupture of the duodenum which were successfully treated by operation, but in such instances, the free intraperitoneal extravasation should produce earlier and more definite symptoms of peritoneal irritation than those following the lesion under consideration, and thus lead to earlier exploration and a lesser mortality rate.

*Operative Methods.*—When simple suture will suffice, it is obviously the method of choice. Elaborate procedures have no place here, since most of these cases are badly shocked and frequently collapse during the operation. However, it may not be possible to close the bowel satisfactorily by simple suture, especially when it is extremely torn, severely contused or necrotic; the choice then is virtually between drainage alone or resection and restoration of the continuity of the gastro-intestinal

tract. With such a lesion in the second portion of the duodenum above the papilla, the operation of choice would obviously be closure of the ends and posterior gastro-enterostomy. The only successfully treated extensive rupture of the third portion of the duodenum I can find was saved by resection with closure of the ends and retrocolic duodeno-jejunosomy. It is worthy of note that Schumacher recommended this procedure four years before the report of this case. Certain of these lesions in the third portion have been treated by closure of the ends and posterior gastro-enterostomy, but this forces the pancreatic fluid and bile to traverse the stomach before reaching the bowel, an obvious objection. With a widely destructive lesion placed in the region of the papilla, the difficulties are extreme. If it is possible to preserve the papilla intact it may be found feasible to close both ends, make a gastro-enterostomy, and implant the papilla in the upper jejunum. If the papilla itself has been destroyed, in theory the ideal operation would be that described by Kausch (*Zentralblatt für Chirurgie*, 1909, No. 39) for cancer of the duodenum; in practice, no case yet reported has apparently been in shape to stand such an extensive procedure. Various compromise suggestions have been made—among others, ligation of both ducts with subsequent cholecystenterostomy and sacrifice of the pancreatic secretion. Considered broadly, even with extensive injury in the region of the papilla, it would seem probably wisest to attempt closure of the opening as much as possible by simple suture and trust to post-operative treatment of the resulting duodenal fistula. The successful case of Cheever (*Boston Medical and Surgical Journal*, 1915, vol. clxxiii, p. 454) emphasizes the possible advantages of such a method. It is to be said, however, that with a widely destructive lesion in the region of the papilla, the outlook is almost hopeless.

*Methods of Approach.*—If one encounters a typical retroperitoneal extravasation in a suggestive case, it is necessary to explore the retroperitoneal portions of the duodenum. The first and a greater part of the second portion of the duodenum is best exposed by Kocher's mobilization. To expose the third and fourth portions it is necessary to raise the transverse mesocolon, as is done preliminary to gastro-enterostomy; at the base of the posterior leaflet of the transverse mesocolon lie the third and fourth portions of the duodenum, covered only by the posterior peritoneum, incision through which renders the duodenum accessible to blunt dissection. The third and fourth portions, together with a considerable amount of the second portion, can be easily worked out of their beds and drawn down for inspection. It is, of course, necessary to avoid the right and middle colic arteries, which are plainly

## RETROPERITONEAL RUPTURE OF THE DUODENUM

visible in the mesocolon; Schumacher states that one can safely ligate the anastomotic branch between these two arteries. This method I have tried on the fresh cadaver and found that the greater portion of the duodenum can be readily exposed. The accompanying illustration

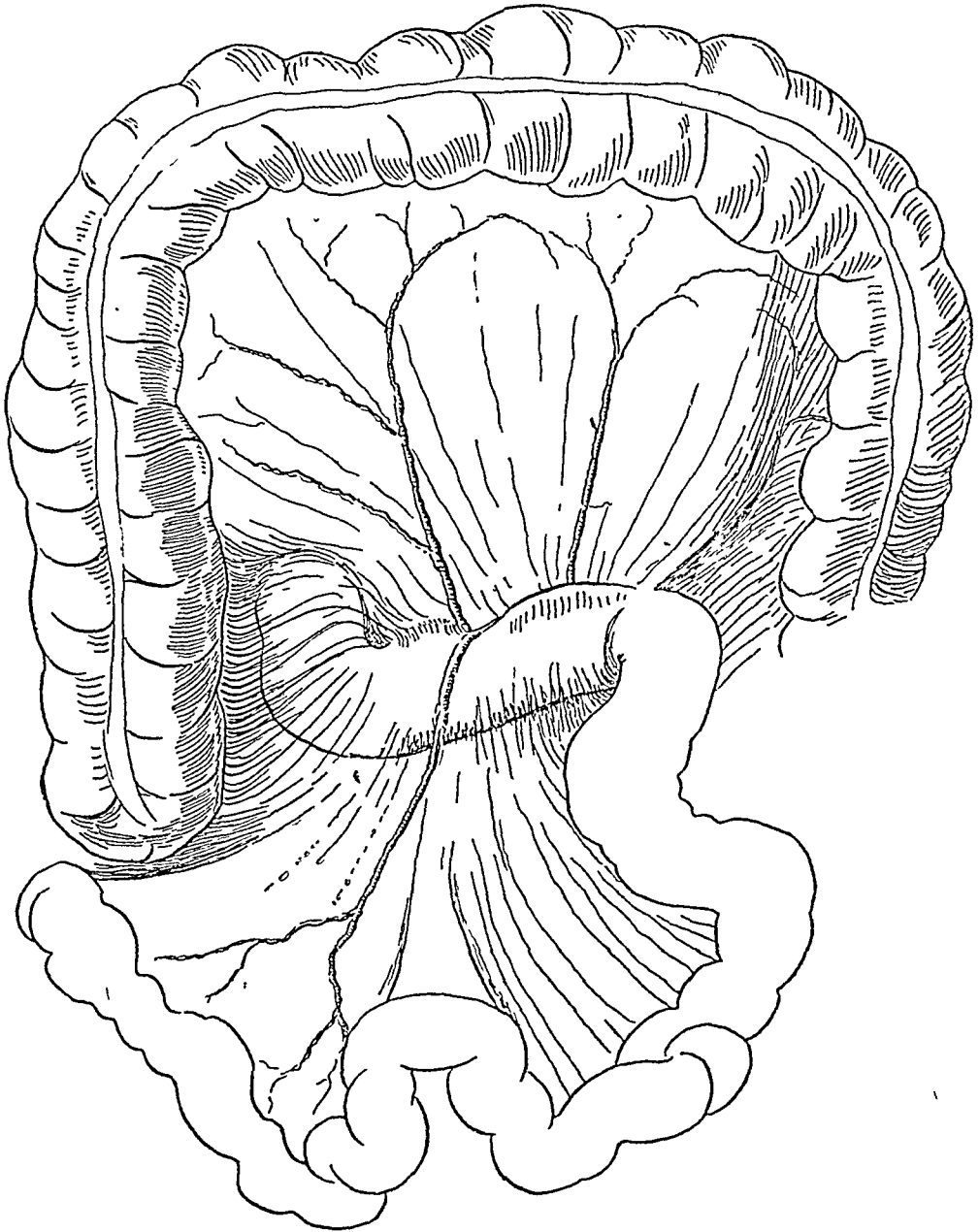


FIG. 5.—The transverse colon and mesocolon have been lifted, exposing a portion of the second and all of the third and fourth parts of the duodenum. To approach this portion of the duodenum, the posterior peritoneum is incised in an avascular area, giving immediate access to the duodenum.

(Fig. 5) shows the method of approach. Jeannel, in 1899, proposed this method, and the modifications subsequently made by Schumacher and Kanavel have served to emphasize its usefulness. Kanavel (*Sur-*

*gery, Gynecology and Obstetrics*, 1914, vol. xviii, p. 484) remarks that he has used this exposure as more or less of a routine in certain cases and found it quite successful, though associated with a rather marked degree of shock. When one is confronted with a typical retroperitoneal extravasation of this type, the procedure of choice is to raise the transverse mesocolon and immediately explore the third portion and the adjoining part of the second portion of the duodenum, since in this area occur the vast majority of such ruptures. Putting the mesentery on stretch by displacing the small intestine to the left of the abdomen will facilitate the procedure considerably.

*Symptoms and Signs.*—It is a striking thing that among these cases comparatively few are greatly inconvenienced by the original injury; very frequently remark is made that they walked home or that they were taken home. Few of them are rendered unconscious. Only a few vomit immediately and pain is in no sense marked. It is only upon the advent of the effects of extravasation that the symptoms become pronounced. Of 16 cases described fairly well, the most constant features are pain and tenderness, almost always generalized and usually maximum on the right side, about the umbilicus or in the upper quadrant. Occasionally the maximum pain and tenderness are to the left of the midline.

An occasional case has marked pain and tenderness in the right flank, in the right back, beneath the twelfth rib, or radiating to the right shoulder. Usually associated with this is corresponding spastic muscle protection, which follows the same general localization as that of tenderness (8 of 16 cases). Distention is usually present, together with vomiting. Dulness is not infrequently noted in the abdomen, generally in the right lower quadrant, or in one or both flanks. There is, of course, associated with this, limited abdominal respiration, rather marked increase in pulse-rate, recorded as high as 160 in one case, and a temperature which varies between 99 and 102.8°. A few cases have a subnormal temperature. Leucocytosis has been recorded very infrequently and it is practically of no great help. Among the odd features noted in symptomatology are retention of urine and occasionally marked cyanosis and lividity (1 case). In this connection may be mentioned a unique case of Berry and Guiseppi (No. 2), in which retroperitoneal rupture of the duodenum resulted in extravasation; the gas worked its way subperitoneally to the anterior portion of the abdominal wall, where it entered the peritoneal cavity by an independent tear in the peritoneum at that point.

## RETROPERITONEAL RUPTURE OF THE DUODENUM

The symptoms as outlined above are virtually the same as those observed in intraperitoneal rupture of the bowel and the same difficulty confronts one in determining whether or not a rupture is present. In general, however, it may be said that severe symptoms are delayed and make their appearance definitely by no means so promptly as with intraperitoneal rupture of the bowel. If diagnosis is difficult with intraperitoneal rupture of the bowel, it is doubly so with retroperitoneal rupture, because of the delay in symptoms. Kanavel observes that rigidity is not very constant with this lesion. In the light of this symptomatology, it is evident that if one waits for a definite diagnosis, the case is almost surely beyond help, hence, we are forced to choose the other horn of the dilemma and operate always in suspicious cases. There are probably few fields in which keenness of observation is at a higher premium than here.

### CONCLUSIONS

1. Subcutaneous rupture of the duodenum forms 10 per cent. or more of the total number of subcutaneous ruptures of the bowel.

2. About one-third of the subcutaneous ruptures of the duodenum occur in its retroperitoneal portion and do not communicate with the peritoneal cavity, as a result of the primary injury.

3. In one-third of the reported cases, the lesion was not recognized at operation, though operation was undertaken on a diagnosis of probable rupture of the bowel. In contrast to this stands the fact that the findings at operation are distinct and practically pathognomonic.

4. The presence of a retroperitoneal hemorrhagic extravasation, occupying the root of the transverse mesocolon and more or less of the adjacent region, with a peritoneal cavity which is grossly clean, is practically pathognomonic of traumatic retroperitoneal rupture of the duodenum and with the presence of subperitoneal petechial hemorrhages and fat necroses over the ascending colon, transverse colon and mesocolon, presents a typical picture.

5. There is a mortality of 90 per cent. or more in this group of cases, as contrasted to an estimated mortality of 70 per cent. in subcutaneous rupture of the bowel in general.

6. The symptoms of such a rupture differ from those of intraperitoneal rupture very slightly excepting that the onset of severe urgent symptoms is somewhat slower.

7. In the fatal cases, extensive retroperitoneal extravasation is constant and together with the effects of duodenal fistula and duodenal toxæmia is, in part, responsible for the high mortality rate.

# ROBERT TALBOTT MILLER

GROUP

No.	Reporter and date	Age	Sex	Injury	Symptoms and signs	Time between injury and operation
1	Berry and Guiseppi, 1909, No. 49	11	M.	Run over.....	Conscious; no severe symptoms. Vomited twice. Pulse 110; respiration 26; temperature 97°. 20 hours after injury became unconscious. Pulse 162; respiration 40; temperature 102.4°. Abdomen rigid and tender. Dulness continuous, with R. H. D. extending to right linea semilunaris in front. Diagnosis made, namely, retroperitoneal rupture of duodenum, largely on dulness which could not be due to hemorrhage, since patient was not pale	No operation, too sick
2	Berry and Guiseppi (Pitt's case), St. Thomas	19	M.	Run over.....	2 hours after accident, shocked, restless. Pulse feeble. No vomiting. No shifting dulness. Emphysema of abdominal wall. Liver dulness absent. Distention. Severe pain	3 hours.....
3	Berry and Guiseppi, No. 118	52	M.	Squeezed between shaft of wagon and wall	On admission, shock. Upper half right rectus rigid. Tenderness about umbilicus. Dulness in right flank. Limited respiratory movements. Vomited 3 times. Pulse 68; temperature 97°. Vomiting, rigidity, distention and dulness increased	14 hours.....
4	Berry and Guiseppi, No. 132	A.	M.	Crushed between tailboard of cart and wall	On admission, limited respiratory motion, considerable tenderness over upper right rectus where hæmatoma was felt. Liver dulness present. No dulness in abdomen generally. No vomiting. Pulse 90; temperature 98.6°. Within several hours after examination, vomited several times. During second 24 hours, pulse 120, temperature 100.2°. Vomiting. Rigidity. R. H. D. present. About 24-36 hours, pulse 140; temperature 101°. Rigidity and tenderness marked. Vomitus fecal. Dulness of both iliac fossæ. Grew rapidly worse	About 30 hour (estimated)
5	Winiwarter, 1912, No. 1	52	F.	Struck in upper abdomen with handle of rake	Six hours after accident, collapsed. Free biliary vomiting. Diagnosis: Perforative peritonitis	24 hours.....

# RETROPERITONEAL RUPTURE OF THE DUODENUM

I

Lesion found at operation	Situation	Operative method	Result
No operation.....	.....	.....	Death in 3 days. Retroperitoneal rupture $\frac{1}{4}$ inch long—junction of parts 2 and 3. Retroperitoneal tissue infiltrated with pus and intestinal contents. No peritonitis. No ruptured kidney.
Mesentery, emphysematous. Rupture not found. Shock during operation	.....	Exploratory laparotomy	Death, 12 hours after accident, 8 hours after operation. Autopsy: Retroperitoneal rupture $\frac{1}{4}$ inch long, $2\frac{1}{4}$ inches from pylorus, junction of parts 1 and 2. Gas in retroperitoneal tissue, then to rent in anterior parietal peritoneum and so within peritoneal cavity. Emphysema, abdominal wall.
Rupture not found. Shock during operation, which was terminated	.....	Drainage.....	Death 16 hours after accident, 2 hours after operation. Autopsy: No peritonitis. Retroperitoneal rupture, two-thirds circumference, 5 inches from pylorus (part 2). Hemorrhage into mesentery and transverse mesocolon. Right kidney partially digested.
Rupture not found.....	.....	Extensive drainage. No mention of peritonitis made on operative note	Death 10 hours after operation. Autopsy: Retroperitoneal rupture of part 3 (behind mesentery, condition of post-peritoneum not stated). Fat necrosis, mesentery. No gas in peritoneal cavity, bile-stained fluid in pelvis, intestines covered with lymph. Right rectus ruptured.
Rupture found. Bile-stained fluid in peritoneal cavity. Hemorrhagic from root of transverse mesocolon to root of mesentery and toward right to reflexion of peritoneum over ascending colon. Incision over swelling. Fat necrosis and small hemorrhages in transverse colon, mesocolon and omentum	Part 3, proximal half, two-thirds circumference of bowel	Simple suture. Drainage	Death eighth day. Generalized retroperitoneal phlegmon, part 1 to pelvis, entire right side and extending into left. Tissues black and gangrenous. Pancreas not involved primarily.



# ROBERT TALBOTT MILLER

No.	Reporter and date	Age	Sex	Injury	Symptoms and signs	Time between injury and operation
6	Winiwarter, 1912, No. 2	42	M.	Kicked by a horse	Vomitus bile-stained. Helped home. Bowels moved. 8 hours after accident, moderate distention, marked spasm, great tenderness, especially on the right. Pulse normal; temperature 101.1°. Pale and anxious	9 hours.....
7	Knaggs, 1913, No. 1	24	M.	Kicked by player's knee near umbilicus at foot-ball	Immediate: "Knocked out," vomited, but recovered and was sent home by train. Pain in right abdomen, continuous after accident. Vomited everything eaten. Admission 24 hours after accident: marked tenderness in right lower quadrant. Abdomen rigid, especially right side. Liver dullness present. Dullness in right loin and right iliac fossa, "a fluid thrill could be obtained" (probably in right iliac fossa). Pulse 120; respiration 28; temperature 99°. "Marked leucocytosis" and hiccough. Did not "look" ill, but felt so	Soon after admission — 26 hours (?)
8	Knaggs, 1913, No. 2	20	M.	Struck near umbilicus by player's knee	Condition several hours later: Lips pale, but condition did not suggest grave injury. Pulse 80; respirations 32; temperature 97.8°. Vomited at examination once, thin brown fluid. Slight abdominal respiration. Liver dullness present. No distention or free fluid. Very slight pain. Slept little. About eighteenth hour: Vomitus contained blood (chemical test). R. M. better but not satisfactory. Pulse 109; respiration 28; temperature 99°. Possibly slight fluid in abdomen. Very thirsty. Twenty-fourth hour: Abdomen: early peritonitis. Pulse 120. Bile-stained vomitus. Moderate leucocytosis	About 26 hours.
9	Clark, 1913....	12	M.	Run over.....	Possibly vomited. Walked ¼ mile to hospital. On admission: Examination negative (abdomen). Next day: Vomiting	24 hours.....
10	Cope, 1913....	?	?	Struck in abdomen with pole	Increased pulse-rate, indication for operation	1 (?)
11	Kanavel, 1914, No. 1	?	M.	Kicked by horse in midline just below umbilicus	Fell. Conscious. Driven home. Vomited within 2 hours, fecal, not bloody. Black stool (medicine). Pain constant, no radiation. General abdominal tenderness, maximum in upper abdomen. 52 hours: Temperature 102.8°; respiration 40; pulse 120; white blood-cells 20,700	52 hours.....

## RETROPERITONEAL RUPTURE OF THE DUODENUM

Lesion found at operation	Situation	Operative method	Result
Rupture found. Peritoneal cavity clean. Slight amount of bloody fluid. Petechial hemorrhages of colon, ascending and transverse, and transverse mesocolon. Bloody gaseous tumor root transverse mesocolon	Part 3, anterior wall; peritoneum intact	Simple suture. Drainage	Recovery complicated by right retroperitoneal abscess from operative trauma to ascending colon. Ruptured into bowel.
Rupture not found. "Dark colored" fluid in peritoneal cavity. No gas or general peritonitis. Extensive retroperitoneal inflammation, right side to pelvis, left side in region of duodenojejunal junction. Most marked about ascending colon near pelvis and about duodenojejunal junction	.....	Closed without diagnosis	Death 2 hours after operation, from increasing toxæmia and heart failure. Autopsy: Retroperitoneal rupture size 3-penny piece, junction of parts 2 and 3. Retroperitoneal tissues and mesentery from right kidney and upper mesenteric attachment, down both sides into pelvis emphysematous and infiltrated with bile and pus.
Rupture found. Dark fluid in peritoneal cavity. No general peritonitis. Right retroperitoneal tissues full of gas and pus from part 1 down behind ascending colon	Rupture. One-half circumference, 1 inch from pylorus, one-half posterior and one-half anterior surface on lateral and not mesial aspect. All retroperitoneal	Simple suture. Difficult and uncertain	Death 24 hours after operation. Pulse 144; respiration 44; temperature 104.0. Autopsy: Large retroperitoneal abscess in right renal fossa. Liver dome adherent to diaphragm. Suture solid and firm.
Rupture found.....	Complete retroperitoneal division, part 3, with slight extravasation	End-to-end suture. Approach: Incision just below root of transverse mesocolon	Death with symptoms of intestinal obstruction (as before operation). Time (?). Advised closure ends and gastro-enterostomy.
Rupture found. Retroperitoneal emphysema	Large rent, part 2, retroperitoneal	Ends closed. Gastro-enterostomy	Death from pneumonia, having done well otherwise. Autopsy: Clean peritoneum.
Rupture found. Free bloody fluid in abdomen	Retroperitoneal perforation of pylorus with laceration of mesentery, part 2	Simple suture. Kocher's exposure	Death 6 hours after operation by toxæmia. Autopsy: Local peritonitis, but violent injection peritoneal surfaces and œdema of subperitoneal tissue.

# ROBERT TALBOTT MILLER

No.	Reporter and date	Age	Sex	Injury	Symptoms and signs	Time between injury and operation
12	Kanavel, 1914, No. 2	?	M.	Crushed in abdomen between wagon pole and telegraph pole	Vomited soon and again within 12 hours, then repeatedly. Severe epigastric pain, but continued to work. Examination: 34 hours after trauma: marked distention with general tenderness, maximum in right lower quadrant. Pulse 126; respiration 32; temperature 97°	34 hours.....
13	Wrede, 1914...	18	M.	Struck in abdomen with piston	Fainted. Immediate pain. Walked home. Great pain 2 hours later, constant and increasing. Admission 20 hours after accident: Temperature 99.6°; pulse 92, regular and strong. Anxious facial expression. No hic-cough or vomiting. Examination, 20 hours after accident: Marked distention, extreme tenderness, maximum left of umbilicus, where also note impaired, otherwise tympanitic	20 hours.....
14	Maddock, 1914	25	M.	Plank dropped from ceiling on right side, struck eighth rib, midaxillary line	Dull aching pain for 3 weeks, pain then severe, especially on respiration. Swelling over rib. Fever every night. Examination 6 weeks after accident: Temperature 101.8°; pulse 100. Very ill, great pain, emaciated. Abscess over centre of eighth rib, right. R. H. D. 1 inch above costal margin. Abdomen distended, general spasm. Bowel movement free, but "chronic peritonitis"	6 weeks.....
15	Keller, 1914, No. 1	18	M.	Fall of 12 feet, striking right flank on bench	No vomiting; marked pain, right side, and 2 hours later had muscle spasm. Admission: Temperature 99.6°; pulse 154. Good color. Moderate distention. Slight general muscle spasm, right more than left. Dulness right flank. Diagnosis: Ruptured liver	12 hours.....
16	Lister (case of Marnoch), 1914	25	M.	Horse fell on rider's abdomen	No record given.....	Immediate operation
17	Cope, 1914, No. 19	16	M.	Crushed between cart and wall	Admission immediately: Abdomen immobile, tenderness over right rectus. Pulse 90; temperature 98°. Next day: Vomiting, pulse 140, abdomen tender, rigid, dulness both iliac fossæ. Fecal vomiting	More than 24 hours, less than 36 hours

# RETROPERITONEAL RUPTURE OF THE DUODENUM

Lesion found at operation	Situation \	Operative method	Result
Rupture found. Clear, thin, bloody fluid. Intestines injected. Fat necrosis in hepatic flexure. Entire retroperitoneal tissue, including pelvis, filled with fluid, serum, bile and intestinal contents. Considerable swelling to right of spine	Longitudinal tear, 1½ inches on level of common duct and below, retroperitoneal	Simple suture. Drainage	Death after 50 hours. No vomiting. Bowels moving. Autopsy: No peritonitis. "Toxic death," yet temperature 103°, pulse 120-160 and respiration 44. Delirious.
Small hæmatoma in mesentery of jejunum at junction. Root of mesentery œdematous. Limited area retroperitoneal purulent infiltration. Stomach and transverse colon distended. Clear exudate about jejunum	Small perforation dorsal wall, part 3	Resection of about 1 inch. Closure of ends. Duodeno- (part 3) jejunostomy, retrocolic. Drainage through mesocolon	Very sick 8 days, then quick recovery.
No laparotomy. Drainage (resection of rib) of abscess of liver and subphrenic space, of intestinal origin	.....	Drainage.....	Death 1 week after operation. Autopsy: Retroperitoneal rupture of part 2, infection spread along eighth rib to liver and subphrenic space. Peritoneal cavity: serous fluid and masses gelatinous matter.
Rupture not found. Blood about liver. Swelling behind ascending colon with thin, "dark tea" like fluid. Condition poor. Operation stopped. Peritoneum clean	.....	Drainage.....	Death 5 days later. Autopsy: subperitoneal rupture, 3.5 cm. diameter, anterior surface junction of parts 2 and 3. General peritonitis from retroperitoneal abscess. Purulent mediastinitis and pleuritis.
Blood-stained fluid in peritoneal cavity. Subperitoneal hemorrhage, mesentery and omentum. Large retroperitoneal hæmatoma opened and drained. Rupture not found	.....	Drainage.....	Death ninth day. Retroperitoneal rupture, transverse, of duodenum part 4. Retroperitoneal cellulitis. No peritonitis mentioned.
Rupture not found. Bile-stained fluid in pelvis, fat necrosis, peritonitis	.....	Drainage.....	Death 11 hours after operation. Autopsy: Retroperitoneal rupture of part 3.

# ROBERT TALBOTT MILLER

No.	Reporter and date	Age	Sex	Injury	Symptoms and signs	Time between injury and operation
18	Cope, 1914, No. 25	29	M.	Knocked down by motor van	Not stated.....	Questionable; probably immediately
19	Cope, 1914, No. 35	15	M.	Crushed between cart and wall	Acute general abdominal pain. Tenderness and rigidity in right side. Abdomen "fixed." Vomiting. Temperature 96.8°; pulse 80-112	5 hours.....
20	Niederle, 1915, No. 1	17	M.	Kicked by horse to right of umbilicus	8 hours after accident: Pulse 84; temperature 101°. Great abdominal pain, maximum to right of umbilicus. Urine negative	8½ hours.....
21	Niederle, 1915, No. 2	44	M.	Struck on abdomen with piece of iron	Did not vomit. Fell, carried off. 3 hours after accident: Temperature 98.6°; pulse 86; respiration normal. Cyanotic, later livid. No blood in stomach contents (tube or vomit?). Abdomen: Distended, painful, maximum to right or about umbilicus. R. M. limited. Retention urine, 250 c.c.	4 hours.....
22	Miller.....	21	M.	Kicked by a mule.	At first very slight pain, went home. Moderate abdominal pain after an unstated time. Negative course for 10 days, then vomiting, visible gastric peristalsis and altered facial expression. Pulse and leucocytes normal throughout. Temperature moderate	Tenth day.....

## RETROPERITONEAL RUPTURE OF THE DUODENUM

Lesion found at operation	Situation	Operative method	Result
Rupture not found. "Tear in mesentery"	.....	Drainage.....	Death few hours after operation. Autopsy: 2 small holes posterior wall, part 2, with retroperitoneal extravasation. Commencing general peritonitis.
Rupture found.....	Not stated.....	Suture of rupture. Gastro - enterotomy. Closure of pylorus	Death: Pneumonia and extensive retroperitoneal cellulitis.
Rupture found. Retroperitoneal hemorrhage behind transverse mesocolon. Incision (probably beneath transverse mesocolon), extravasation. Peritoneal cavity clean at operation	Junction parts 2 and 3. Two-thirds circumference ragged edges. Retroperitoneal	Simple 2-layer suture. Posterior gastro - enterotomy. Drainage	Death. Duodenal fistula on tenth day. Starvation. Death, fourth week, after pyloric occlusion.
Rupture found. Bloody fluid in peritoneal cavity, fibrin on small intestine, without sign of injury. Hæmatoma of omentum, also evident about duodenum, after {transverse mesocolon raised	Junction parts 2 and 3. $4\frac{1}{2}$ cm. in diameter	Simple 2-layer suture. Posterior gastro - enterotomy. Drainage	Recovery.
Rupture found. Retroperitoneal abscess	Part 2, 2 ruptures	Drainage.....	Death. Autopsy: 2 retroperitoneal duodenal ruptures, extensive retroperitoneal suppuration. Mild fibrinous peritonitis.

# ROBERT TALBOTT MILLER

No.	Reporter and date	Age	Sex	Injury	Signs and symptoms
					<b>GROUP II: RUPTURE OF GUT</b>
	Lonhard, 1911....	23	M.	Crushed between railroad cars	1 hour after injury, admission. No urgent symptoms. 3 hours after injury, great pain, retracted abdominal wall with marked tenderness and spasm in left lower quadrant. Temperature 99.8°; pulse 100. Marked vomiting
					<b>GROUP III: SIMULTANEOUS</b>
1	Quenu and Mathieu, 1912	19	F.	Run over.....	1 hour: Pulse 110. Abdomen distended, tender, general muscle spasm. Drawn face
2	Favreul, 1913....	20	M.	Crushed between wagon and wall	.....
3	Cheever, 1915....	15	M.	Run over by auto.	Walked home, great pain. 1½ hours after accident: Pulse 50; blood-pressure 110; respiration and temperature normal. Slight shock, slight general tenderness and spasm. Maximum tenderness, left umbilicus. Dulness both flanks, not shifting. 4½ hours after accident: Pulse 84. Sicker. Abdominal pain. Marked tenderness in right iliac fossa, scarcely any in epigastrium. Vomited
					<b>GROUP IV:</b>
1	Keller, 1914, No. 2	27	M.	Struck on abdomen by board	Vomited, but walked home. Great pain in back. Abdomen soft. 12-18 hours later: Vomited twice, muscle spasm. Admission: Appearance good. Pulse 84. Abdomen: Muscle spasm and tenderness left hypochondrium
2	Berry and Guiseppi, 1909, No. 63	15	M.	Run over, level of umbilicus	Collapse. Vomited once. No sign injury. Next day: Abdominal pain, frequent vomiting, pulse rapid and feeble

# RETROPERITONEAL RUPTURE OF THE DUODENUM

Time between injury and operation	Lesion found at operation	Situation	Operative method	Result
<b>AND PERITONEUM WITHOUT PERITONITIS</b>				
3 hours.....	Rupture not found. Peritoneal cavity clean, little bloody serum. Small area of ecchymosis of mesentery and bowel wall, midpoint small bowel. $\frac{1}{2}$ No free gas	.....	Closure.....	Death 16 hours after operation. Autopsy: Peritoneal cavity clean, no gas. 200 c.c. bloody fluid. Complete transverse tear of part 3, with rupture overlying peritoneum. The slightest, most limited inflammation of peritoneum adjoining. Retroperitoneal infiltration from right kidney into pelvis, bile-stained. No associated injury. Cf., leak into peritoneal cavity prevented by overlying mesentery.
<b>INTRAPERITONEAL AND RETROPERITONEAL RUPTURE</b>				
1 $\frac{1}{2}$ hours.....	Rupture found. Intestinal extravasation. Intra-peritoneal rupture at junction of parts 1 and 2, anterior wall. Retroperitoneal rupture directly opposite	.....	Simple suture. Drainage of flank	Recovery.
1 hour.....	Rupture of jejunum found. Hemorrhagic infiltration beneath parietal peritoneum maximum at root of mesentery and about hepatic flexure	.....	Suture of rupture of jejunum, 30 cm. from duodenojejunal junction. Drainage of flanks	Death after 24 hours. Autopsy: Suture intact. Peritoneal cavity clean. Findings similar to operation and rupture of part 2, 2 cm. diameter, with intact peritoneum. Retroperitoneal extravasation, extent not mentioned.
8 hours.....	Rupture found. Free gas and blood in peritoneal cavity. Rupture intra- and retroperitoneal	Part 1, 3 cm. diameter, posterior wall, one-half within peritoneal cavity	Simple suture	Recovery.
<b>INCOMPLETE RUPTURE</b>				
About 24 hours, probably more or less	Free blood in peritoneal cavity. Fat necrosis omentum. Hæmatoma over right kidney and reaching into transverse mesocolon. Peritoneum opened, contusion pancreas, 3 cm. diameter. Contusion posterior wall, part 2	Part 2, posterior wall	Suture and drainage	Well, 7 weeks.
No operation..	.....	.....	.....	Death. Autopsy: Subcutaneous rupture of part 2. Large hæmatoma between muscularis and peritoneal coats, causing obstruction.



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## CHRONIC APPENDICITIS AND ITS RELATION TO VISCEROPTOSIS\*

BY ARCHIBALD MACLAREN, M.D.  
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THE operation for the removal of a chronic appendix is so common, and it is so often unsatisfactory to both the patient and the surgeon, that it has seemed to us wise and timely to enter into a short discussion of the reasons for this frequent disappointment. If the patient suffered no harm from the removal of a supposedly chronic appendix, or if there was no danger in the removal of a simple appendix, this question would not be so important. Every practising surgeon knows, or should know, as we will later show, that many patients are harmed by the operation for the removal of the so-called "chronic appendices," occasionally one dies as a result of operation; we have had at least one death, years ago, from the removal of a chronic appendix.

Now what do we mean by the term of "chronic appendicitis"? First, we are not talking about the relapsing type—a patient who has once had a true acute attack of appendicitis is always in danger, and even after years of perfect freedom is liable to have the old inflammation flare up again.

We do not believe in the chronic appendicitis *not associated* with at least one true acute attack. Of course, an attack of peritonitis may be due to any one of a large number of causes. If the patient never has had an attack of severe illness we have established one of the most important pieces of negative evidence with which to start our history of a case which we may be investigating. But suppose there has been a severe illness (of course, the patient frequently believes that the one acute attack of inflammation was something else than appendicitis), cross-examination will usually define the difference; if without suggestion to the patient we ask for a description of the "mild attack of typhoid," or the attack of "inflammation of the stomach, bowels or womb," we ought to be able to tell at least that there was or was not a true attack from some cause, even when we cannot locate its source. In our experience the patient is not able to be up and about with even a very mild attack of peritonitis, and with an attack of inflammation of the appendix, is practically always confined to bed and usually

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\* Read before the American Surgical Association, May 11, 1916.

has some vomiting. So that if we get a history that the patient was laid up in bed from three to five days, that there was vomiting, that the doctor found a rise in temperature, that there was pain on pressure or upon movement, we may feel sure that there was an attack of peritonitis. If the first of these two symptoms has not been present, the case under consideration probably did not have an attack of appendicitis. To-day every surgeon believes that he can distinguish between the true and the false—or neurasthenic imitation of appendicitis. It seems to us to be one of the most difficult surgical problems to make this diagnosis. The class of cases which we have in mind is well described by Mr. A. J. Walton in the *British Journal of Surgery* of October, 1915, under the title of "Clinical Aspects of Visceroptosis." Mr. Walton had 373 cases of true appendicitis in a period of four years; during the same time 67 cases of visceroptosis were subjected to abdominal exploration. These cases he divides into four groups:

1. Cases resembling appendicitis, both acute and chronic: acute 13 cases, chronic 16 cases, making a total of 29.
2. Cases resembling gastric ulcer, 27 cases;
3. Cases resembling gall-stones, 6 cases;
4. Cases resembling carcinoma of stomach, 5 cases.

These 67 cases were all practically errors in diagnosis, as is seen by studying the carefully reported histories of each case. The operations were not done for the purpose of correcting the ptosis, in fact, Walton, and every other surgeon of experience, concludes that the results of operative treatment in these cases are very unsatisfactory. These are the so-called neurasthenic cases, but no one, so far as we can find, has described this class of cases from the surgical point of view to our satisfaction. The surgeons all agree that the neurasthenic should not be operated upon, but they do not tell us how to distinguish between the case of true appendicitis and the neurotic counterfeit. Deaver, in his book on *Appendicitis*, gives the impression that it is easy to make a differential diagnosis between chronic appendicitis and the neurasthenic even when there has been no preceding acute attack. In Deaver's fourth edition, 1913, under the heading "Recurrent Appendicitis," he says, "The diagnosis of chronic appendicitis is usually clear. The plainer cases give a history of acute pain referred to the region of the appendix, and examination reveals definite soreness, and upon palpation over this region even in the absence of an acute attack a diagnosis may be made with almost invariable accuracy on this combination alone, i.e., pain and tenderness in the right inguinal region." We are sure that this is not true, not only from our own ex-

perience but more particularly because we see so many uncured cases: cases with pretty appendicular scars, but whose symptoms are *worse rather than better*—cases that have been operated upon during the past two years, by good men, not only in the West but by well-known surgeons in the East as well.

Deaver says, "a normal appendix is a rarity in the adult." There are a number of pathological conditions which like chronic appendicitis are, to say the least, questionable, as for instance, Jackson's membrane, mobile cæcum, Lane's kink, one or all of which usually accompanies visceroptosis. Some surgeons and their pathological friends have assumed that these conditions are proved, and that they are surgical; we feel that they are not proved, and that it will take years of careful study to determine when they are surgical and when they are not.

We have all taken it for granted, for instance, that obliterative appendicitis was the result of, or produced by, an inflammatory state of the appendix. But when such good pathologists as Ribbert, Wölfler and Zuckerkandl, quoted by Kelly, after a careful examination of a large number of cases of obliterative appendicitis, all arrive at the conclusion that these conditions are not due to inflammatory changes, but were an involution process in a functionless organ; it makes us hesitate to accept other minor pathological changes in the appendix as important lesions. In a case of relapsing appendicitis the appendix is usually buried in adhesions, while in obliterative appendicitis it is often quite free with no adhesions about it at all. The neurasthenic, or visceroptosis case, sometimes simulates the acute, but usually is mistaken for chronic appendicitis. These, as a rule, are young women or girls from twelve to twenty-four years of age (occasionally in older women, rarely in men) who are not in good physical condition, have lost from 10 to 15 pounds in weight, are worrying over family or financial troubles, or over examinations at school; they are of the flat-chested, scaphoid abdominal type, and when it is necessary for them to stand a great deal are often flat-footed. They have pain in the head, back, pelvis, or abdomen due to their general debility; they complain of tenderness on pressure in various parts of the abdomen; many of them complain of this tenderness mostly in the right inguinal region, and these are the ones who come to us for operation. But just as large a number come to us on account of abdominal discomforts after their appendices have been removed. These cases, as Walton, referred to above, says, are frequently temporarily relieved but in a few weeks their old symptoms recur, as is shown in his histories. It has seemed to us that these neurasthenic cases are improved by our

unintentional exercise upon them of the faith cure. For if we honestly believe that we have removed the cause of their distress we do unconsciously exercise this power whether we believe that we do or not. It has seemed to us that this pain and tenderness in the right inguinal region, in these cases, was usually due to the stretching of the duodenum from its fixed point under the liver to the ptosed pylorus in the pelvis. There is seldom any rise in temperature, the pulse is normal as a rule; occasionally in the younger patients it is rapid from excitement, probably due to the examination. There is no true abdominal rigidity, and the pain in the abdomen in the chronic cases will be lessened or will disappear when the patient lies down. This last point has seemed to us to be perhaps the most important point in making a differential diagnosis between the true and the false appendicitis.

If the case which we have described is operated upon, what happens to her? The appendix is found to contain some slight evidence of disease, and, to-day, we believe that every appendix is pathologically condemned by some pathologist somewhere. We are always under these circumstances reminded of the pathological condemnation of every ovary and tube ever seen twenty years ago.

The operation is a success, the wound is perfect, but she has lost at least five pounds in weight, and when she is encouraged to get up and about, to prove what great surgeons we are, her headache in her abdomen comes back, sometimes in the same place, unfortunately it sometimes comes back somewhere else; then the inexperienced surgeon concludes that the pain is due to some other organic lesion which he has overlooked and advises some further operative interference. We have often heard that it takes a patient a year to recover from an operation for chronic appendicitis, which ought to prove that the operation was unnecessary, because it does not take anything like that length of time to recover from the removal of an acute appendix even after abscess formation.

All of us have seen these patients after they had suffered several laparotomies, as, for instance, we saw a few weeks ago a patient with eight scars on her abdomen who was provoked when we refused to remove her only remaining ovary, that being the only removable organ left in her abdomen.

If these patients are not operated upon what can we do for them? The internal medical man has been curing these patients for years by the "old-fashioned rest cure" process. Years ago we would advise an operation in consultation and find to our amazement that when the patient is rested and built up and had gained about ten pounds in weight

her abdominal distress had almost disappeared and that the abdominal or pelvic pains would not come back, unless for some cause weight was again lost. Even when these cases cannot give up their work and take a regular rest cure, on account of expense, a *modified rest cure* is better for them both physically and financially than a useless operation. Six fat meals a day and lying down every minute that they can get away from their work helps immensely. We have, at a moderate estimate, seen, in the last four or five years, 100 of these cases, some of them being sent to us for the purpose of having their appendices removed, some to find out what was the reason of their continuing ill health. Almost all of these cases have gotten well without operation, which to our mind is the acme of surgical success.

We have already pointed out in our study of gastropotosis presented to the American Surgical Society in 1911, that this type of patient was the one that we had previously operated upon, usually for chronic appendicitis, without effecting a cure. In that communication we were able to show by X-ray that the stomach was ptosed and atonic, that they still had their same point of pain and tenderness in the right iliac fossa even after their appendices had been removed.

We have taken for this study 225 consecutive operation cases, commencing January 1, 1906, operated upon in our own private practice, with the result that we find that there were 12 cases which were, we now believe, without X-ray confirmation, neurotic or gastropotosis cases. We give the following tables as a complement of this paper:

TABLES

1. Chronic appendicitis, woman, aged twenty-four years. No improvement two years after operation.
2. Gastric ulcer, woman, aged fifty-eight years. No improvement.
3. Chronic appendicitis, man, aged twenty years. No improvement.
4. Chronic appendicitis, woman, aged twenty-five years. No improvement three years after operation.
5. Chronic appendicitis, woman, aged twenty-five years. No improvement six weeks later. Gastro-enterostomy, two years later, died, perforated duodenal ulcer.
6. Chronic appendicitis and retrodisplacement, woman, aged twenty-four years. Dilatation for dysmenorrhœa; appendectomy and retrodisplacement operation, worse.
7. Chronic appendicitis, retrodisplacement, woman, aged twenty-eight years. No improvement in eighteen months.

8. Gastric ulcer, chronic appendicitis, three years ago; operation, cervix and perineum. No better one year later.

10. Chronic appendicitis, woman, aged nineteen years. No results one year later.

11. Chronic appendicitis, woman, aged thirty-six years. Operation for laceration of cervix and perineum, one year ago. Mucous colitis two years, few adhesions; Jackson's membrane. One year later no improvement.

12. Chronic appendix, woman, aged thirty-five years. No improvement.

Résumé: Eight cases of chronic appendicitis. Three cases of supposed gastric ulcer with one death, and one pelvic case.

We have then skipped six years and taken up our histories in the same way commencing January 1, 1912, the year after we had written on gastropotosis. In the next 225 cases we find that there were only six operative errors as against twelve of the six years before.

#### 1912

1. Chronic appendicitis, Jackson's membrane, woman, aged twenty-one years. No improvement.

2. Pelvic chronic appendix, Lane's kink, woman, aged thirty-five years. No improvement.

3. Chronic appendicitis, girl, aged fourteen years, Jackson's membrane. No improvement.

4. Chronic appendicitis, girl, aged sixteen years, Jackson's membrane. No improvement.

5. Chronic appendicitis, woman, aged fifty-seven years. Blood in stools, Jackson's membrane. No result for two years.

6. Chronic appendicitis, girl, aged nineteen years. No result.

## PSEUDOMUCINOUS CYST OF THE APPENDIX COMPLICATING RUPTURED ECTOPIC GESTATION

BY NATHANIEL GINSBURG, M.D.  
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PSEUDOMUCINOUS cyst of the appendix has occurred, according to the researches of Dodge, sufficiently often to make the collection and study of 142 cases possible. It is the belief of the writer that this condition, like many other surgical states, occurs with greater frequency than the literature leads one to believe. Reference to the paper of Dodge, appearing in the *ANNALS OF SURGERY*, March, 1916, affords a complete review of the subject. The writer desires to add the report of a case of cystic dilatation of the appendix occurring in a patient who was primarily operated upon for a circumscribed pelvic hæmatoma, the result of a ruptured right tubal pregnancy of some weeks' duration.

The patient, thirty-seven years of age, was admitted into the Jewish Hospital of Philadelphia on the writer's service in June, 1915, complaining of pain and tenderness in the lower abdomen and vaginal bleeding. Examination revealed a tumor occupying the right aspect and almost completely filling the pelvis, and giving the resistance to the examining finger of a cystic mass. In view of the patient's history, which was quite definite, exploration was done and a ruptured right tubal pregnancy with encapsulation was found. After dealing with the pelvic condition, the appendix was examined and found to be the type of pseudomucinous cyst first described by Virchow in 1863.

The following report of the appendix was dictated at the operation: The appendix is a sausage-shaped mass lying in the right iliac fossa below the cæcum, having a concave mesenteric border. The size can best be estimated by reference to the photograph. The meso-appendix consists of a thin peritoneal veil containing very small appendiceal vessels which were easily ligated by a single ligature. The peritoneal surface of the appendix is almost entirely avascular, and the wall of the organ is thinned out to a degree approaching veil-like transparency. The mucosa, completely atrophied to the muscularis, has entirely disappeared, owing to intra-appendiceal pressure. The serous surface is fairly smooth, and presents three distinct diverticuli in two or more places near the proximal end of the organ. One of these diverticuli is very large, almost the size of a small walnut,



lying close to the mesenteric border of the organ, and, where the wall is thinned out, presents a secondary out-pouching. The wall of the appendix appears to be thinner where the diverticuli exist, no doubt due to less mural resistance at this point. The appendix contains a thick semitransparent gelatinous material which is retained by an apparent closure of the proximal end of the organ. The entire appendix is involved in the process, and examination of the specimen definitely establishes mechanical closure at the cæcal end of the appendix. There are no adhesions or evidence of inflammatory disease contiguous to the appendix, since the appendix was not adherent to the right tubal mass which lay entirely below the brim of the pelvis.

Close questioning of the patient following the operation revealed the fact that there had been definite periods of right iliac discomfort preceding the onset of the tubal rupture, no doubt attributable to the cystic distention of the appendix in this region.



FIG. 1.



# CYSTIC DILATATION OF THE VERMIFORM APPENDIX

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CYSTIC dilatation of the vermiform appendix is sufficiently rare to warrant a report of three such specimens. In reporting one case recently in the *ANNALS OF SURGERY*, Dodge<sup>1</sup> very thoroughly reviewed the literature and tabulated reports of 142 other cases. As a result of his study of these he deducted the following conclusions:

1. That cystic dilatation of the appendix is a relatively infrequent condition.
2. That true hydrops of the appendix is rare. Probably less than 9 per cent. of all appendiceal cysts.
3. That appendix cysts are essentially retention cysts and of inflammatory origin.
4. That the condition by no means runs a symptomless course; symptoms being present in at least 51 per cent. of operative cases, and 24 per cent. of all cases.
5. That the contents of certain appendiceal cysts, when implanted upon the peritoneal surface, are capable of producing a condition of pseudomyxoma peritonei.
6. That certain appendiceal cysts present structural and clinical characters that seem to ally them with adenocystomata.
7. That carcinomatous changes occasionally take place in appendiceal cysts.

The accompanying photograph (Fig. 2) illustrates a specimen sent from the operating room to the laboratory of the Louisville City Hospital with a clinical history in brief of five typical attacks of appendicitis during a period of three years. The patient was a white male, twenty-one years old. At operation the banana-shaped, dilated, cystic appendix was found free from adhesions and attached in normal position by a short, cord-like base which was twisted about one-third. This cord was ligated, the appendix was removed as usual, and the patient made a speedy and uneventful recovery. The gross examination showed the following:

Specimen consists of a banana-shaped appendix measuring 16.5 cm. along its distal border and approximately 3.5 cm. in greatest diameter. About 5 cm. from proximal end it is bent toward mesenteric border to make an angle of 120 degrees. Organ is pale, tense, thin-walled, fluctuates and

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<sup>1</sup>Dodge, George E.: Cystic Dilatation of the Vermiform Appendix, *ANNALS OF SURGERY*, March, 1916.

apparently is distended with translucent fluid. Beneath serosa tortuous, dilated capillaries stand out prominently. No adhesions or diverticula are found. Peritoneum is everywhere smooth and glistening. Distal half of mesenteric border bears moderate amount of fat covered with intact peritoneum, while proximal half presents cut meso-appendix. Proximal end terminates in a cord-like stump, 6 mm. in diameter and 15 mm. long, which is ligated with a catgut suture. After fixation in Kaiserling fluids a cross-section of this stump proximal to ligature reveals pale, firm, solid tissue in which no lumen is apparent. On gentle compression of cyst no contents can be expressed after ligature is removed. When specimen is slit open along mesenteric border, thin, watery, translucent fluid escapes. Inner surface is everywhere pale, flat and smooth, but is not so smooth and glistening as serosa. No opening can be found in pedicle, although inner surface slopes toward centre of this in a conical depression. Wall measures from paper thinness to 2 mm. in thickness.

*Microscopic Examination* (Fig. 1).—Section of proximal portion of pedicle shows mucosa obliterated and replaced with fibrous tissue. Organization tissue and muscularis are infiltrated with leucocytes among which lymphocytes and plasma cells predominate largely. Section through base of pedicle where it broadens into cyst shows usual wall of appendix with mucosa, submucosa and muscularis, being also moderately infiltrated with lymphocytes and plasma cells chiefly. Section of wall of cyst shows a thin lining of epithelial cells, the remains of mucosa. In this an occasional shallow pocket is seen into which lining epithelium dips. Muscularis is much compressed and attenuated and infiltrated slightly with lymphocytes and plasma cells.

*Microscopic Diagnoses*.—(1) Pedicle: healed, obliterated appendix.  
(2) Wall: compressed appendix wall with slight chronic inflammation.

The cystic dilatation of this appendix evidently followed an inflammatory process which was more or less localized in the proximal end of the organ and resulted in obliteration of the lumen at that point. Continued secretion on the part of the mucosa in the remainder of the organ led to an accumulation of retained fluid which gradually distended the lumen until pressure caused the thinning and atrophy of the wall as found. Unfortunately no cultures could be made in the laboratory without damaging the specimen for museum purposes, as it had not been kept under sterile conditions after removal. Consequently there was not any opportunity to try to determine the exact etiological agent.

Dr. W. C. Dugan, of Louisville, who operated in this case, states that he has removed two similar appendices, one about 25 per cent. larger and one considerably smaller. In both of these cases the patients had been subject to typical attacks of appendicitis and each recovered uneventfully after appendectomy. In all three cases Dr. Dugan noted that no adhesions had been formed, indicating a lack of any great amount of inflammation in the distal portions of the appendices.



FIG. 1.—Photomicrograph of section of cyst wall. Note thinned mucosa and small pocket which is evidently the remains of a gland (x200). (Photo by L. S. Brown, Massachusetts General Hospital.)



FIG. 2.—Cystic dilatation of vermiform appendix.



## MAJOR SURGERY UNDER MINOR ANÆSTHESIA \*

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MUCH of the danger from every major operation is the danger of the anæsthetic. Much of the post-operative morbidity, many of the post-operative complications, and many of the post-operative deaths are due to the anæsthetic. In intra-abdominal operations, most of the post-operative distention, both gastric and intestinal, much of the vomiting, much of the pain, of the inability to move the bowels, of the shock, cardiac depression and many of the other so-called post-operative complications, are in reality post-anæsthetic sequelæ. With some operations the mortality is appreciably higher if a general anæsthetic is used. Take, for example, gastrostomy for malignant stricture of the œsophagus. This comparatively simple operation has a relatively high mortality when done under ether. I can recall numerous deaths after this operation done under ether, some at my own hands, some at the hands of colleagues. Some of these patients were in comparatively good condition, and I was on several occasions struck by the fact that death was probably due to ether pneumonia. Of late I have been doing gastrostomy and jejunostomy under novocaine, and there is a striking difference in the post-operative course; and, moreover, the operations can be done painlessly. Twice in the past few months I have done a Kader gastrostomy and once a Witzel jejunostomy under local anæsthesia. In each case I had an anæsthetist present and in each case the patient declined to take ether during any stage of the operation; and all these patients, run down by inoperable carcinoma, assured me that the procedure was quite painless.

How often are we confronted by patients who we say are bad operative risks, when we mean they are bad anæsthetic risks. Take some of these patients and give them ether for forty-five minutes or longer, and do no operation on them at all, and they will have a stormy time for several days, and some of them might even die as a result of the anæsthesia. Very recently I had a trying experience of this kind. A man of fifty-two fell and a radiograph taken four days later, when I first saw him, showed a fracture of the neck of the femur with outward rotation of the foot. There was no previous history of diabetes but

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\* Read before the New York Surgical Society, May 10, 1916.



we found albumin, casts and glucose in the urine. He was given anæsthesia just long enough to put the fragments in good position, and apply the Whitman plaster-of-Paris splint in abduction. Immediately following the anæsthesia he developed a marked acidosis, and in spite of all treatment died in coma a week later.

It is a well-known fact that patients are much less uncomfortable and have less post-operative complications after a short than after a long operation. This means they have had less ether and therefore are less sick. If we take away the ether altogether, or do only a small part of the operation under ether, is it not natural to expect a much smoother convalescence? Some years ago I looked up all the operations on the gall-bladder and ducts, done during the same period of time by several surgeons working at the same hospital. I found that there were seldom any complications after short operations, whereas the patient who had received ether for more than an hour frequently had a stormy convalescence. A full dose of morphine should precede operations under local anæsthesia. In prostate cases I give morphine by hypo and an opium suppository a half hour before operation. In appendix cases of late I have been giving two injections of morphine, one an hour before operation and one fifteen minutes before operation. I gave up spinal anæsthesia some years ago because the last patient upon whom I used it had complete incontinence of fæces and retention of urine lasting six weeks. In former years I used cocaine, stovaine, eucaine, and alypin, but have given them all up on account of the great advantages of novocaine. It does not irritate the tissues, even in strong solutions; and even in large doses it has no depressing effect on the heart. I have repeatedly used as much as 240 minims of a 1 per cent. solution and have never seen any bad effects therefrom. Others have reported using 20 c.c. of a 2 per cent. solution, while Braun goes so far as to say that 250 c.c. of a 1 per cent. solution can be used with safety in adults. Personally I have never used more than a quarter of that amount. In very vascular tissues, such as the gums, smaller amounts should be used.

But novocaine alone is not nearly as satisfactory as the combination of adrenalin and novocaine. This combination is what I prefer to use in all operations under local anæsthesia, and in my experience it is the most safe and satisfactory local anæsthetic that we to-day possess. The adrenalin not only increases the action of the novocaine but it appreciably prolongs the time it acts. On mucous membranes, however, novocaine is not nearly as efficacious as cocaine.

Novocaine can be sterilized, either by boiling, or by placing the solu-

tion contained in a bottle in the sterilizer with the dressings and leaving it there fifty minutes. The mouth of the bottle should be stopped with absorbent cotton to prevent excessive evaporation of the solution. To prevent its decomposition the ordinary solution of adrenalin usually has added to it hydrochloric acid and some antiseptic such as thymol. In this form the adrenalin solution can be sterilized by heat, and, if placed in a dark bottle, can be kept a long time; the addition of any alkali will tend to cause decomposition of the adrenalin. But in the tablet form both adrenalin and novocaine keep very much better than in solution. It is difficult to sterilize the tablets; they should be dissolved in water and sterilized just before use. I usually make up enough for each operation separately.

Lennander has shown both at operations and experimentally that the principal parts of the abdomen that are sensitive are the anterior and the posterior parietal peritoneum, pelvic peritoneum, and the peritoneum covering the diaphragm as far as it is innervated by the spinal nerves. The visceral peritoneum, stomach, intestines and omentum, even in the presence of acute peritonitis, and the peritoneal covering of the gall-bladder, liver and kidneys, are quite insensitive. This does not mean that pulling on these organs may not cause pain, and even other sensations such as nausea or a feeling of faintness. I have not always found the omentum free from sensation and prefer always to anæsthetize it before dividing it. The stomach and intestines are not sensitive, but I usually prefer to anæsthetize the mesentery before ligating it, just as I always inject novocaine into the mesenteriolum of the appendix before ligating it and cutting across the appendix. But I have always found the wall of the stomach and of the intestines entirely free from sensation; neither have I ever noticed any pain in cutting across the base of the appendix. The mesentery is often very sensitive, although in doing intestinal resections in strangulated herniæ it is not necessary to anæsthetize the mesentery. But the reason for this is that the mesentery has lost its sensation as a result of the prolonged strangulation. The sensations caused by pulling on any of the abdominal organs or by clamping or tying off the mesentery are very different from the sensations of pain. Some patients cannot localize these sensations, and some say they are almost unbearable unless the mesentery is anæsthetized; some patients complain of nausea and faintness. Lennander and Braun both found that the fundus of the gall-bladder can be clamped and cut without causing any pain, but if an attempt is made to pull the gall-bladder forward, or if the ducts are probed, pain will be elicited. Tying off the cystic artery or the cystic duct causes pain. Incising the

liver is not at all painful. Introducing and removing large gauze packings is distinctly painful. But I can say from personal experience that the opening and closing of the abdomen and the removal of the appendix or ovary, gastrostomy, cholecystostomy, and intestinal resections can be done painlessly under local anæsthesia.

*Hernia.*—For years I have occasionally been operating on inguinal, femoral as well as umbilical herniæ, under local anæsthesia, but of late, especially with my private cases, I am offering local anæsthesia to all of them, and most of them accept it. I have repeatedly operated on umbilical herniæ without ether, several times in very nervous patients, and have had no difficulty whatever. Some of these patients have had previous operations under ether, and they all noticed the remarkable increase in post-operative comfort. In inguinal herniæ it is advisable to block the iliohypogastric and ilioinguinal nerves near the upper end of the skin incision. Each layer should be anæsthetized separately, and novocaine should be injected into the neck of the sac, and also into the omentum if it is to be resected. That an extensive intestinal resection can be painlessly done under novocaine, the following case will clearly show:

Frieda N., sixty-nine years old, was admitted to the First Surgical Service of Mount Sinai Hospital, January 12, 1916. Twenty-four hours before admission, after taking a cathartic, she had had a sudden cutting pain in the hypogastrium, and a mass appeared on the left inguinal region. She had vomited three times, the pain had persisted, and she was unable to move her bowels. On admission a very tender swelling, the size of a hen's egg, was found in the left inguinal and femoral region. Attempts at reduction, both before and after admission to the hospital, proved ineffectual. I undertook the operation shortly after admission. On opening the sac it was found to contain some bloody fluid and a loop of necrotic small intestine. There was no pulsation in the mesentery, and to ascertain the viability of the gut the mesentery was cut at right angle to its vessels. The mesentery was incised two inches to one side of the necrotic gut and four inches to the other side before active bleeding was encountered. Ten inches of gut were removed, the ends of the gut crushed and ligated, and each stump buried with two rows of linen sutures. A typical side-to-side anastomosis with Connell linen sutures was done. The typical Bassini operation for femoral hernia was then carried out. The operation consumed one hour and fifteen minutes and had been preceded by a full dose of morphine. Novocaine and adrenalin made the operation entirely painless, and at no time

## MAJOR SURGERY UNDER MINOR ANÆSTHESIA

did the patient complain of any pain. She made an uneventful recovery. In view of her advanced years and the extensive operation that was necessary, a general anæsthetic would have been associated with considerable danger.

*Appendix.*—During the past year I have been developing a technic for removing the appendix under local anæsthesia and have had eighteen cases which I have reported in the *Jour. A. M. A.* of April 8, 1916. To quote: "The first great objection will be the difficulty in dealing with adhesions. The adhesions we find are of two classes, fibrous and omental. The fibrous adhesions are not sensitive and can be readily divided. The omental adhesions can be readily anæsthetized by injecting into them a few drops of local anæsthetic. In a few minutes the adhesions can be ligated and divided without any pain. A few of my cases have been acute, one an empyema of the appendix; the remaining cases have been subacute or chronic. The right tube and ovary can be drawn into the wound and can be resected or excised if necessary. I hope in the near future to use this method in more and more acute cases, even in the presence of peritonitis. In fact, a peritonitis, far from being a contra-indication to doing the operation under local anæsthesia, will, I hope, soon be an indication for this operation. When we consider that the system is already struggling to throw off a peritoneal infection and that the organs of excretion are doing a large part of this defensive work, the danger of handicapping these organs still further by giving an anæsthetic is apparent to us all. And if we can remove an offending appendix in the presence of a peritonitis under local anæsthesia, we are giving our patient a far better chance for a rapid recovery.

"There is another important point. We all know how peristalsis is inhibited after abdominal operations under ether, and how serious a complication tympanites may become. In the cases in which I have operated under local anæsthesia, there has been very little or no tympanites, and peristalsis has been little, or not at all, inhibited. In a recent case of empyema of the appendix in a young woman, gas began to be passed fifteen hours after operation, and at no time was there any abdominal discomfort; nausea, vomiting and tympanites were entirely absent. In another recent subacute case the patient was reading the newspaper on the day after operation.

"Three of my cases were intelligent private patients, and the remaining cases were from the First Surgical Service of Mount Sinai Hospital. Each patient was asked if he or she was willing to have the operation done under local anæsthesia. Some of the patients were neurotic women, but most of them were fairly intelligent. Of course, the coöper-

ation of an intelligent patient is an advantage, and I would hesitate to do the operation on a young child.

"I was led to do this work by the following case:

"Mrs. W. M. R., a patient of Dr. Alfred Schwab, had an acute attack of appendicitis in March, 1915. She had a bad heart, with pulse up to 120, a marked nephritis, enlargement of the liver and ascites. When I first saw this patient with her doctor I refused to operate on her. On the following day the symptoms of acute appendicitis became more severe, and I decided to try to remove the appendix under local anæsthesia. The patient, a very intelligent woman, kept up a running conversation with us during the operation; and, when it was completed, she assured us that the pain had been trifling. I saw this patient recently and she was in a very good condition. Had the operation been done under ether I fear we would have had a far different result.

"With increasing experience I have modified the technic somewhat. In my earlier cases I used the local anæsthetic only in the abdominal wall. But we found that most patients complained, either when the appendix was being drawn into the wound, or when its mesentery was being ligated.

"The technic which I now employ is as follows:

"Half an hour before the operation the patient receives a quarter of a grain of morphine hypodermically. I usually use a 1 per cent. solution of novocaine, to an ounce of which 20 drops of 1:1000 solution of epinephrin are added. As much as 240 minims of this solution can be safely used for an adult, which would correspond to about  $2\frac{1}{2}$  grains of novocaine. As a matter of fact, I have never found it necessary to use anything like that amount to do a painless appendectomy.

"I have for years had a personal preference for the muscle-splitting McBurney incision, and use it in most of my cases, acute as well as chronic. This incision lends itself particularly well for the operation under local anæsthesia. The skin near the anterior superior spine is not very sensitive; but by far the greatest advantage of an incision in this location is the fact that it comes right down on the cæcum. Rarely is it necessary to pack away the small intestines (although this can readily be done without causing pain), and there is thus less handling of the intestines. I first inject the novocaine solution into the skin along the line of proposed incision. In doing this I try to blanch the skin with the injected solution. Then I inject under the skin, along the same line.

## MAJOR SURGERY UNDER MINOR ANÆSTHESIA

"After a wait of three minutes, the skin and subcutaneous tissues are painlessly incised down to the aponeurosis of the external oblique. A sharp scalpel is used for dividing all layers, as scissors, being blunter than a knife, are more apt to cause pain. I next inject novocaine under the external oblique aponeurosis, and after two minutes divide it. The solution is next injected into the internal oblique muscle, parallel to the fibres of the muscle.

"After another wait of a few minutes the internal oblique is cut parallel to its fibres. We then inject a little novocaine under the peritoneum and wait fully three minutes before dividing it. If done in this way, there will be no pain up to this point. All manipulations should be as gentle as possible, on the part of the operator and of the assistants. Only a sharp scalpel should be used in dividing the various layers of the abdominal wall. It is rarely necessary to apply artery forceps in opening the abdomen through this incision, which is an additional advantage, as the crushing of the blood-vessel with forceps may cause some pain, unless the novocaine is injected around the vessel. If necessary a packing can be introduced to keep the small intestines out of the way, although it is rarely necessary with this incision.

"As soon as the cæcum with the appendix is exposed, the novocaine is injected into the mesenterium. If this is not done, and I omitted to do it in my earlier cases, the patient will complain of cramp-like abdominal pain referred to the navel or pit of the stomach. By anæsthetizing the mesenterium this pain is obviated. After a wait of three minutes the appendix can be pulled out of the abdomen, the mesentery ligated and divided and the appendix removed with almost no pain. It is not necessary to inject novocaine into the base of the appendix before ligating and removing it. If the mesenterium is properly anæsthetized, there will be no pain during the removal of the appendix. It is perfectly feasible to draw the right tube and ovary into the wound and do any operation on them that may be indicated. The abdomen is closed layer by layer in the usual manner, and, if the technic has been correct, the closure of the wound is entirely painless.

"I have kept a record of the statements of the patients concerning the amount of pain they felt during the operation. Most hospital patients will say that they felt some pain, but much less than they expected. My three private patients have all assured me that the operation was quite painless.

"The post-operative course is of much interest. A few hours after operation there is a little wound pain which is readily controlled by codeine or morphine. Peristalsis is regularly established early, in from

fifteen to twenty-four hours, so that the troublesome and painful post-operative distention is completely absent. I have recently had an acute case in which, during the entire convalescence, no rectal tube was inserted and no enema or cathartic was given. This patient had not the slightest sign of nausea, had fluids up to a few hours of the operation, and continued to take fluids after operation; yet the operation was done in the acute stage, and pus was found inside the appendix. Almost all of the patients have been able to take and retain fluids within a few hours after the operation. The post-operative depression so common with ether is entirely absent. Most patients are reading on the day after operation, and are sitting up in bed on the third or fourth day; in short, smooth and rapid convalescence, even in the acute cases, is a most striking phenomenon. The patients are usually able to get out of bed on the fourth or fifth day, and are ready to leave the hospital between the seventh and ninth days.

"I have described the operation as done through an intermuscular incision, but the operation can also be done under local anæsthesia through any other incisions for removing the appendix. For the reasons stated above, I believe the incision I have used to be the most desirable."

*Prostate.*—I believe I was the first to advocate and to practise the removal of the prostate gland through a suprapubic incision without ether or chloroform. In my original paper on "Suprapubic Prostatectomy under Nitrous Oxide Anæsthesia," published in 1904, I stated, "The chief contra-indications to the performance of prostatectomy have until recently been the dangers resulting from, first, the general anæsthetic; second, hemorrhage; third, shock. By the use of laughing-gas, the great objection of a general anæsthetic is at once removed. If, in addition, we do rapid work, then all three of the objections are removed. A prostatectomy, done under nitrous oxide in from eight to fifteen minutes, is not accompanied by any danger from the anæsthetic; the hemorrhage in those few minutes is very moderate and there is no shock. Many surgeons have held that a man unfit for general anæsthesia is unfit for prostatectomy. In view of our experience with laughing-gas are we not justified in asserting that view is erroneous?"

In 1903 I did my first two-stage prostatectomy, using laughing-gas for the first as well as for the second stage. Since then I have been gradually increasing the percentage of cases in which I do the two-stage operation, until in the past few years I carry it out in every case, using local anæsthesia for the first stage, and nitrous oxide for the second. There cannot be any doubt in the mind of any surgeon who has done the operation repeatedly in one stage and in two stages that the mortality

in a series of cases will be lower with the two-stage operation. I cannot bring myself to agree with those surgeons who do the operation in one stage if the patient is in good condition. After a moderately large experience in these cases, and from what I have observed of them at the hands of others, I have come to the conclusion that we are rarely in a position to say that any of these old patients is in "good" condition. And no matter how carefully we examine these cases before operation, no matter how many tests we make to determine the functional capacity of the kidneys, we are never in a position to state with assurance which one of these patients will be able to overcome the shock of operation. So to my mind the only safe thing we can do is to lessen the shock as much as possible in each and every case, whether the patient appears to be in good condition or not. And the shock of operation can certainly be lessened by doing the operation in two stages, using novocaine for the first stage, and laughing-gas for the second. I am glad to be able to say that I have never used ether or chloroform in any prostatectomy, and it goes without saying that I have never had an ether pneumonia in this class of cases. It has been my experience that some of these patients who seem the poorest risks will go through the operation, done in this way, with the most surprisingly smooth convalescence, while some who seem excellent risks are often badly shocked by a simple cystotomy. I know of no other safe rule than to consider all these old men bad risks and to give them the benefit of every possible safeguard, they need them all. As I said in a former paper, "Few surgeons will deny that in desperate cases the two-stage operation is safer; but they will tell you in good cases it is not necessary. And that is where the danger to the patient lies, that he will be taken for one of the "good" cases. And unfortunately some of these good cases, after a prostatectomy, turn out to be anything but good."

*Empyema.*—Simple incisions, even extensive resections of the ribs, can be done under local anæsthesia. The parietal pleura is sensitive but is readily anæsthetized. The pulmonary pleura, like the visceral peritoneum, is not sensitive, and the same can be said of lung tissue. Even in children one or more ribs can be readily removed under novocaine.

*Subphrenic Abscess.*—I have repeatedly opened such abscesses under local anæsthesia. The most recent case I have had was that of an old lady who had many of the symptoms of subphrenic abscess, but repeated aspirations by various men failed to show pus. The radiograph showed a large shadow in the region of the right subphrenic space. Under local anæsthesia, I resected the eighth rib in the axillary line and sewed the two layers of pleura together. I then aspirated through the diaphragm,



found pus, and opened an abscess containing at least eight ounces. The operation, done under local anæsthesia, presented no difficulties, and the patient made a good recovery.

*Bones.*—Periosteal and bone sensibility varies greatly with different individuals; thorough anæsthetizing of the periosteum very much lessens this sensibility. I recently had an old gentleman of sixty-two referred to me who had a marked endocarditis not well compensated, and both his physician and his children were very much opposed to his taking ether. He had an infected bunion which had been opened, and resulted in an extensive infection of both the adjoining phalanx and the metatarsus, and there was also extensive cellulitis of the foot. I did not think I could do a painless operation under novocaine, but as the family was insistent, I undertook it. I made incisions on the dorsal and plantar aspects of the foot to drain the cellulitis, excised the infected bursa, resected the base on the phalanx of the big toe and also the head of the metatarsus, which was badly infected. I used novocaine freely in the soft parts, after applying a Martin bandage to the leg, and I was careful to inject novocaine under the periosteum of the phalanx and of the metatarsus. At no time during the rather extensive operation did this old gentleman complain of pain.

*Varicose Veins.*—I have repeatedly removed even extensive varicose veins under novocaine. If a Martin bandage is applied, the action of the local anæsthetic is even more efficacious. The following case was a most unusual one:

Miss K., a trained nurse, after lifting a heavy patient, had suddenly noticed a swelling in her left groin. Immediately thereafter she had vomited and fainted. She was employed at that time in one of the German University clinics. The attending surgeon diagnosed femoral hernia, and she was given ether preparatory to having it operated on. Before the operation had been started she collapsed, and was resuscitated only with great difficulty. No operation was attempted and she was told that she should never try to take ether again. For ten years following this experience a small swelling remained in the groin but did not cause much discomfort. She then began to have pain in the left leg and thigh at frequent intervals, with occasional swelling of the foot and leg. During all this time the diagnosis of femoral hernia was adhered to. I first examined this case eighteen years after the onset of the trouble. I found a small elastic swelling in the left groin just below Poupart's ligament. It was quite tender and not reducible. There was no evidence of any varicose veins and I concurred in the diagnosis of irreducible femoral hernia. At the operation done under local anæsthesia I was very much sur-

prised to find that the swelling consisted of the enormously distended common femoral vein which was filled with a firmly organized clot. I resected the vein and the patient made a good recovery, and has had no further trouble.

*Combined Local and General Anæsthesia.*—How often are we confronted by the question whether a given patient can stand an operation, whereas the question really is, can this patient stand a prolonged anæsthetic? Many patients of advanced years, many cases of cardiac and renal disease, fall into this class. And there can be no denying that the amount of ether that is given in one of these cases bears a very important relation to the prognosis. The following case is a striking example:

Mr. K., forty-nine years old, had had several attacks of cholecystitis. He had had two attacks of angina pectoris, had albumin and casts in the urine, a blood-pressure up to 190, and he had been told by several physicians of his various organic lesions. One consultant advised him not to be operated on, chiefly on account of the danger of an anæsthetic. After a rather severe attack of cholecystitis, I obtained his consent to operation on condition that I would do as much of the operation as possible under local anæsthesia. With novocaine I made a ten-inch cross-incision below the free border of the ribs, divided the rectus and oblique muscles, and opened the peritoneum without causing the patient the slightest pain. He testified to this at the time and also later. When I began to put in packings to wall off the very much enlarged and thickened gall-bladder, he began to complain of pain. A skilled anæsthetist then gave him gas and ether for about 15 minutes, during which time I separated and removed an adherent gall-bladder with stones, and sewed up the end of the cystic duct. The anæsthesia was then stopped and the abdomen closed. This patient did not vomit once during the first 48 hours after operation, there was no sign of shock, and he required no heart stimulants. His kidneys caused us no concern at any time. In spite of all the handicaps this man was laboring under, he made a prompt and good recovery. All of the gentlemen associated in this case believe that the patient owed his recovery, at least in large measure, to the short time he was under ether.

Does not such a case open a wide field of usefulness for combined local and general anæsthesia? Have we not all had operative deaths in this class of cases that could have been avoided?

I have made no attempt to cover the entire field of operations under local anæsthesia, but have rather tried to show some of the work that can

be satisfactorily done. The advantages of this kind of work will, I think, be apparent, from what has been said above. There can be no doubt that since major operations under local anæsthesia are still in their infancy the future holds a wide field for their development. Personally, I look forward to doing more and more operative work in this manner; and I am looking forward with considerable enthusiasm to doing more work with the combined local and general anæsthesia. Who will deny that it is a great advantage to do a difficult cholecystectomy with only fifteen minutes of ether? And how much ether we can save in a pylorectomy case that often takes one and one-half hours or even longer to perform. All of the suturing of the stomach and intestine, the opening and closing of the abdomen can be done painlessly under novocaine. And will we not have an appreciably lower mortality with many complicated abdominal operations if we reduce the time of anæsthesia to a small fraction of what it now is? We will often be able to get along with a short gas and oxygen anæsthesia, combined with local anæsthesia, in cases where we now use ether for forty-five minutes or longer.

Are there any inherent objections to operations under local anæsthesia? Surely there are. First, is the fear of causing pain. With increasing experience, with proper technic, with proper selection of cases, by combining local with brief general anæsthesia, pain will in large measure be eliminated. And even if pain were not entirely eliminated in some cases, the lessened danger of the operation, the fewer post-operative complications, the wonderful difference in post-operative comfort, would weigh heavily in favor of such procedure. That operation under local anæsthesia takes more time is true; but if we figure ten or fifteen minutes to get the patient under ether, the difference in time for many operations will not be marked. I have several times done a double inguinal hernia operation under local anæsthesia in an hour. One objection is a real one. It is more trying for the surgeon to operate under local than under general anæsthesia. There is the additional mental strain of encouraging the patient to keep quiet and to keep up his courage. The coöperation of an intelligent patient is a great help. In any case we can arrange our day's work so that not too many operations under local anæsthesia are done at one sitting. Even if it is much more trying to do major operations without general anæsthesia, should we not sacrifice our personal comfort for the great advantages that accrue to the patient? The answer to that question will in large measure determine the field of usefulness of this procedure at the hands of each individual surgeon.



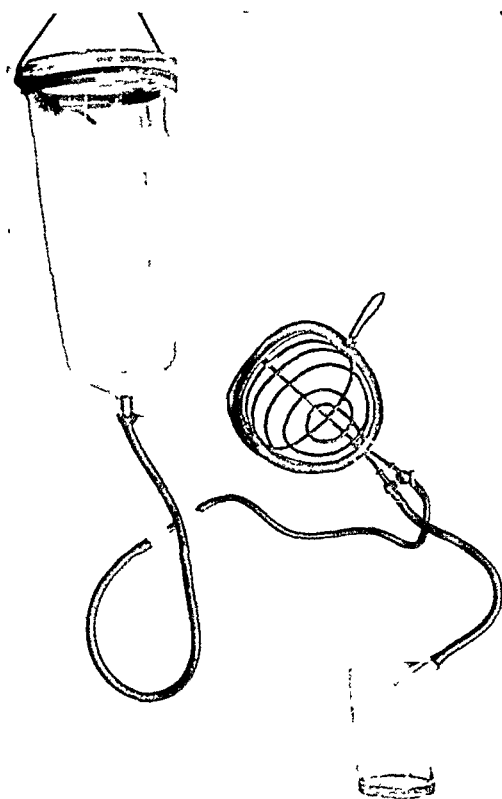


FIG. 1.—Apparatus for warming ether during inhalation.

## DEVICE FOR WARMING ETHER DURING INHALATION

BY J. E. ENGSTAD, M.D.

OF MINNEAPOLIS, MINN.

*Construction.*—An ordinary ether inhaler mask is reinforced with a coil of German wire tubing of No. 12 gauge. To both ends of the tubing a stop-cock is fitted, which aids in controlling the flow of the warm water through the tubing.

Experience has shown that water of a temperature of 121 degrees gives the best result.

A percolator or any receptacle capable of holding water is attached to one stop-cock with a rubber tube, and is elevated about 3 feet above the mask. To the other terminal a tube is fitted to lead the returned and cooled water to a basin.

*Mechanical Advantages.*—As an ordinary ether mask the spiral wire reinforcement adds strength and a framework for the gauze which is much to be desired in the ordinary inhalers.

Gases expand and the molecules are broken up as to the square of the temperature. It follows that the molecules, being smaller and less stable if warmed, enter the blood circulation with increased rapidity, are more diffusible, and more rapidly eliminated, than if the drug was inhaled and absorbed in a less diffusible form.

Amount of ether used is proportionately reduced. It is safe to state that at least one-third less is necessary for narcosis where heated gases are used than where the fumes are more or less atomized, instead of vaporized into the highest possible unstable molecules, which are rapidly absorbed.

If we minimize the loss of heat by supplying by mechanical means to balance the loss of energy by the expansion of gases, we to a certain extent obviate the chilling of the respiratory organs. The absorption of heat by the gases is to prevent the transmutation of innocuous germs in the respiratory tract into virulent ones by lowering the temperature. We thereby, in a marked degree, minimize the danger from ether pneumonia.

Furthermore, the gases being more diffusible when warmed, the quantity of the drug used is less and the destructive changes in the organs are reduced proportionally, which all tends to a more rapid and complete recovery.

# RESULTS OBTAINED BY THE USE OF RADIUM IN THE TREATMENT OF CANCER OF THE UTERUS

AT THE UNIVERSITY OF PENNSYLVANIA HOSPITAL

BY JOHN G. CLARK, M.D.

OF PHILADELPHIA, PA.

THE treatment of cancer of the uterus—that will-o'-the-wisp of surgery—has for the last three decades been a bone of contention as regards the best method of circumventing the growth by surgical methods. The various forms of hysterectomy have been thoroughly tested, beginning, first, with the simple vaginal method, a large series of cases thus treated having been reported from American and European clinics. The final summary of results, however, after a probationary five-year period, showed the treatment to be lacking in effectiveness, first, because it was applicable to only a relatively small number of cases, and, second, because the percentage of ultimate cures it yielded was lamentably small. Then came Schuchart's more radical vaginal hysterectomy, which, in the hands of a few experts, among the foremost of whom is Schauta, has given a larger rate of ultimate cures; it is, however, a very difficult operation, and is attended by a larger mortality, and is followed by serious vesical and ureteral sequelæ. Because of these objections, this method has received only limited approval from gynecologists.

Following this, the extended or more radical abdominal method came into vogue, and until three years ago continental gynecologic literature was replete with the reports of cases from many clinics; these contained both favorable and adverse criticism. About three years ago these reports suddenly ceased, to be almost entirely superseded by the consideration of radium and mesothorium as new and promising therapeutic agents.

This brief discussion of the rapid change of events in the surgical treatment of cancer leads to the inevitable conclusion that the surgical world is still very much at sea as regards the most effective method of dealing with this disease. A decided surgical advance has been made, but the progress is in no way commensurate with the effort that has been expended, for even in carefully selected cases the best series of radical operations still yields less than 50 per cent. of recoveries.

As a convincing evidence of the limitations of surgical applicability, we offer the results of our experience. In less than two years we have

## RADIUM IN CANCER OF THE UTERUS

treated 49 cases of inoperable cancer of the uterus with radium, and during the same period only 12 cases have been considered as within radically operative limits. During the preceding ten years the number of radical operations performed was about 60. In other words, for 50 cases subjected to operation, at least 250 have been abandoned as hopeless. This personal observation has convinced us, more than ever before, of our grave shortcomings as regards the surgical treatment of uterine cancer.

Although the radical operation has given the best ultimate statistics, so far as the number of permanent cures is concerned, experience has proved that beyond doubt, it is also attended with an unavoidably high primary death-rate; that it is followed by serious post-operative sequelæ which are difficult to cure, and that when these are irremediable, they leave our patients in a very wretched condition. Since the American Gynæcological Society so thoroughly reviewed this subject four years ago, I have found no reason to alter my views as expressed at that time after a study of my own cases. The conclusions then reached were as follows:

1. The operation, in expert hands, notwithstanding its high primary mortality, has given the greatest percentage of permanent cures of any therapeutic procedure thus far suggested for cancer of the cervix.

2. While the foregoing conclusion is true, the general adoption of the operation, in view of its dangers and difficulties, is not to be advised until the primary mortality can be reduced to a much lower percentage by a simplification or a perfection of details.

3. The abandonment of the extensive glandular dissection is justified, because this detail adds to the hazards and does not sufficiently increase the percentage of permanent cures.

4. The cardinal advantage of the operation lies, first, and above all, in the excision of an extensive cuff of vagina and the widest possible removal of the parametrial tissue.

5. There is no middle-of-the-road policy in cancer of the cervix. The surgeon would better perform a simple vaginal hysterectomy or a high amputation of the cervix with extensive cauterization than to attempt the radical operation if he is not prepared effectively to execute its details.

6. The earnest endeavor, by many specialists, with the improved ultimate cures in a few hands, offers the hope that a further simplification and perfection of details in this operation may yet make it more generally available.

The therapeutic problem involved in the successful treatment of carcinoma of the cervix is based upon the stage of invasion of the new-growth. The results of the radical operation have proved conclusively that, with very rare exceptions, the hopeless cases are those of the metastatic type. All the methods now being employed are, therefore, directed



toward the radical elimination of the local cervical and vaginal disease process. If the growth has invaded the parametrium to a point beyond the outer limits of the ureters, or if it has found lodgement in the iliac glands, the case must, with rare exception, be regarded as hopeless, so far as surgical extirpation is concerned. This statement may be challenged, but in that case the burden of proof falls upon the challenger. No operation as yet suggested has been more generally misapplied than has the so-called radical abdominal operation. This may be proved to one's own satisfaction by examining the specimen exhibited, as a rule, as the product of this operation. This criticism is directed not alone to the work of other surgeons, but applies with equal force to my own. There can be no more difficult surgical procedure than the radical operation for the removal of a cancerous uterus, for the efforts of the operator are impeded on all sides by insuperable limitations.

To attempt to compare the statistics of the various operators is a difficult or impossible task. In one clinic the greatest risks are taken, and an attempt is made to operate on hopeless cases in the belief that a dangerous hazard is always warranted, because thus an occasional brand may be snatched from the burning. Conversely, another surgeon, with less temerity, and possibly with better judgment, will operate only on cases that promise to reward his efforts and that are unmistakably within his surgical domain. The latter operator will, therefore, have fewer cases than the former, and, of course, his series will show a correspondingly higher rate of permanent cures. Then, too, the variation in skill of different surgeons plays an important rôle in the estimate of results. Because this skill varies so widely, and is so largely dependent upon the temperament and physical equipment of the surgeon, the standardization of the radical operation for cancer, whose degree of effectiveness is defined within the widest anatomic limits under the most hazardous of surgical liabilities, must remain forever upon shifting sands. In many operations the limited nature of the disease and its accessibility are such that more or less fixed principles of procedure may be evolved, and in these cases skill and judgment do not influence the operative results so profoundly.

In the anatomic division of cancer of the uterus this point may well be demonstrated, for in carcinoma of the fundus the statistics of various surgeons do not differ to any marked degree, because extirpation of the uterus generally suffices to give good results. So long as the growth is confined to the fundus, recurrence does not take place in more than 50 per cent. of cases, provided even a simple hysterectomy is performed. The rule, therefore, that calls for removal of the uterus

## RADIUM IN CANCER OF THE UTERUS

and its adnexæ may, in the hands of a mediocre operator, be productive of a mortality incidence and a permanent percentage of cures approaching closely those of his more skilled colleague.

We are all fairly well satisfied with the results of operation in cancer of the fundus, whereas no one regards the operative treatment of cancer of the cervix with any great degree of optimism. To attain a higher measure of success, some more efficient means than the scalpel must be employed. That this remedy has not as yet been discovered is shown by the fact that almost every surgeon who has made a special study of this question very properly advocates the same principle here as has been adopted in cancer of every other part of the body that is accessible to radical surgical measures. Notwithstanding the remarkably good results that have followed the use of radium, I still adhere to the dictum that the uterus and all possible adjacent tissue, if the growth is very limited in its extent, must be extirpated. Beyond this point, however, I have grown quite conservative. My first recession occurred eighteen years ago, after visiting Sanger's Clinic. I found that this very clever surgeon and clear thinker had even then abandoned hysterectomy as a palliative measure in widely extended cancer, on the ground that practically no hope of cure could be offered the patient, and that removal of the uterus actually intensified her subsequent suffering. Following a hysterectomy, if carcinomatous tissue is left in the parametrium, the patient's post-operative state is likely to be worse so far as pain is concerned, for it is usually severer and, therefore, more prolonged than if the uterus is allowed to remain *in situ*. With the removal of the uterus, the elastic broad ligaments and parametrium retract and cling closely to the pelvic wall, coming in contact with the large pelvic blood-vessels and the sacral plexus. If the growth remains in this situation the condition is infinitely more painful than if it is held in suspension away from the pelvic wall by the broad ligaments, and, therefore, more slowly reaches the periosteum and ganglionic roots.

The crux of the situation, therefore, as our experience has taught, is to attempt surgical measures only in the clearly operable cases, leaving the large remainder to secure relief from therapeutic efforts, which give as good or, as we now believe, even far better results from the use of radium.

In the inoperable cases, I believe the Percy cautery holds out a distinct hope; nevertheless, I do not share the great degree of optimism shown by the inventor of this method as regards the cases of wide-spread extension. In using the cautery, as in performing the radical operation, the anatomic barriers are the same, and I am firmly convinced that

its general adoption will be followed by even a larger number of serious and wretchedly disabling sequelæ, so far as the rectum, bladder and ureters are concerned. This cautery should be used only by the skilled specialists, for it is not safe in the hands of the novice. Even in skilled hands accidents are prone to occur in many instances. Moreover, one cannot get away from the fact that the Percy method is most radical, involving an abdominal section, ligation of the internal iliac arteries—a procedure that may be quite difficult in some cases—and the prolonged exposure of the patient to the slow desiccation of the tissues. This method must, therefore, be regarded as on trial, and it is to be hoped that its enthusiastic sponsor will publish a full account of cases up to date. We should know the mortality percentage and the degree of morbidity following the operation in order fairly to estimate its full value. Because of the fact that a sufficient quantity of radium was at our disposal at The University Hospital, we have followed this line of treatment almost exclusively, and we have had, therefore, but a limited experience with the desiccating method.

Under the best of clinical conditions, we are forced to throw into the surgical discard by far the largest proportion of cancer cases registered in our clinics. If we are still holding a very conservative opinion as to the final results following the Percy method, what, it may be asked, is our attitude toward the Röntgen ray treatment and the use of radio-active substances?

In this country the X-ray has not had sufficient trial to give it a place of even tentative value. To Bumm's Clinic, from which very favorable preliminary reports were issued, we looked for an elaboration of technic that would serve as a standard for comparison with radium and mesothorium. The Great War has, however, put an end to all investigation in the gynæcologic clinics of Germany, and it is only from the hospitals of the continent, where there is an abundance of material and also a willingness to risk much, so far as individual patients are concerned, to work out a theoretic principle, that we may expect authentic reports of hazardous novel procedures. The röntgenologist cannot be depended upon for convincing reports, for his cases are drawn from widely divergent sources, and too often the clinical diagnosis is accepted and no microscopic control attempted.

As to radium, I am convinced from our experience at the University Hospital that it offers the most helpful outlook of any remedy thus far presented in the palliative and occasionally the curative treatment of the border-line and inoperable cases. In the Gynæcologic Clinic of the University of Pennsylvania during the past two years, 44 cases of

## RADIUM IN CANCER OF THE UTERUS

carcinoma of the uterus, vagina, and urethra have been so treated. Practically all of these would, according to our past standards, have been classed as inoperable and, therefore, would inevitably have been doomed.

As regards the effect of radium when applied in too large amounts and too often, Schauta's experience is enlightening: In his first series of 13 patients, from 50 to 100 mgs. of radium were applied uninterruptedly for from three to eleven days, and repeated in similar dosage after an interval of from twelve to twenty-two days. His results were most disastrous: one patient died of pyonephrosis; 8 showed steady loss of weight, with diarrhoea, tenesmus, fever, vomiting, headache, and reduction in blood count. The autopsy findings showed severe necrosis and fistulæ with diphtheritic and purulent inflammations of the rectum and bladder, sigmoiditis, and ulcerative processes in the pelvic coils of the ileum. *One striking point, however, noted at the autopsies was that in not a single instance was a trace of local carcinoma found.* In the method of its application, however, the remedy proved far worse than the disease, but this investigator established beyond question that radium emanations were absolutely destructive to cancer cells.

In a second series of 11 cases the dosage was smaller and the interval of application shorter, but in spite of this some of the patients presented the group of disagreeable symptoms just noted, but in four a local cure was effected.

In his third series of cases the dosage was regulated as follows: From 30 to 50 mg. of radium, filtered through 1.1 mm. of gold, 1 mm. of platinum, and 0.75 mm. of brass, were applied in from 5 to 8 exposures of twelve hours each, at intervals of from one to several days; an interval of rest of three to four weeks was then allowed to elapse, followed by a second but shorter exposure, and in some cases, after another interval of two to three weeks, a third series of applications was employed.

Eleven patients were thus treated; of these, 3 were somewhat improved and the remaining 8 were apparently cured. In no instance were fistulæ or necrosis produced, and the weight and general condition of the patient showed marked improvement.

As an evidence of the wide-spread skepticism concerning these newer remedies, and in spite of this very favorable personal experience, Schauta declares that, although he will use radium in advanced cases, he will still continue to employ Schuchart's radical method of per-

forming vaginal hysterectomy in the clearly operable cases, reserving radium as a post-operative prophylactic agent.

With a less intensive method than that at first employed by Schauta, we have thus far had but one patient in whom a fistula developed; this followed a radical operation in which 50 mg. of radium were left within the vaginal cuff for eight hours, another application being made in six weeks. In this case there was no apparent retardation of the growth; on the contrary, within two months great sloughing holes appeared in the rectum and bladder. Whether these were caused by the radium or were due to the rapid growth of the carcinoma we were unable to determine. In practically every case radium has been applied for twenty-four hours, and the patient has usually returned home the next day. So far as any immediate effect is concerned, in no instance have we witnessed any untoward symptom beyond a fleeting degree of nausea, and this but rarely; only in one case did a high temperature develop, and this was in a case in which the Percy cautery had been applied extensively, and was followed by a twenty-four hour application of radium. In our series of cases there have been, with these two exceptions, no disagreeable effects. Fortunately, we have not had to pass through the experimental stage of this treatment but have profited by the mistakes of the early workers. Thus far we have found an 85 to 100 mg. dosage quite satisfactory. It is possible that still better results may be achieved by larger amounts. For information on this score, however, we must turn to Drs. Kelly and Burnam.

We have adhered strictly to one rule, namely, never to attempt an operation on any case that has been healed locally by radium. It appears to us a most unwise surgical policy to subject a patient to the grave hazards of a radical operation, after the radium has acted beneficially, in a fatuous attempt to secure still more effective results. With further experience we may modify this rule, but up to the present we have not seen the slightest evidence in favor of so apparently unwise a policy.

Radium, as is shown in our series of cases, is by no means a universal panacea for cancer, even when the growth is strictly localized. There is no way of determining which cases will be benefited by its use. There is beyond doubt a certain percentage—how small or how great we cannot tell from our experience—in which cancerous growths are not retarded by radiotherapy; indeed, occasionally it would appear that there is a positive acceleration of growth. That many cases show an astounding improvement and local cure cannot be gainsaid. In our series several instances occurred in which the results achieved were so

## RADIUM IN CANCER OF THE UTERUS

remarkable as to be almost incredible. Whether in these cases the fire is but smouldering and may break out sooner or later with renewed violence time alone will tell.

In the discussion of these cases the question of hospital economics must not be lost sight of. The length of stay in the hospital following a radical operation will average at least three weeks; whereas after the application of radium not more than three days will be required. When complications arise after radical operations they are usually serious, entailing much suffering. Such patients, on returning home, are likely to remain semi-invalids for several weeks, and when, as is frequently the case, there is a rapid continuation of the disease, they become a heavy burden to a poor family. In the comparison of statistics, this difference between the two classes of patients is greatly in favor of those treated by radium, a fact that tends to incline us strongly to the use of radium in border-line cases, which we formerly subjected to a radical operation.

It would also appear to be a self-evident fact that the post-operative effects of the Percy method must fall far short of those of the radium cases. I cannot here enter into a discussion of ultimate curative results, even though at present they may appear most promising, for we are on the very threshold of a therapeutic innovation that may, in the end, prove of less value in effecting a cure than the radical method of performing a hysterectomy.

Removal of the uterus in cases of cancer of the fundus has yielded such good results that I do not feel we are justified in taking any chances with radium, not even in the border-line cases. *Our attitude toward the cervical and fundal growths is diametrically opposite. In border-line cases of cancer of the cervix we invariably employ radium. In advanced cases of cancer of the fundus we invariably perform a hysterectomy.* A pessimistic view dominates our outlook in the surgical treatment of the cervical growths if the pathologic process is at all advanced, whereas fundal growths may be viewed with a cheerful optimism even when the cancerous process is extensive. As a palliative agent, we may assert with full assurance that we have never obtained results with any other method that have even approached in beneficence those secured by radium. The cloud, however, that hangs over the remedy is the danger of unbridled optimism.

The following three tables are appended, as they give the final results in the radical operation for cancer of the fundus and the palliative results in cases treated by radium during the last two years. A very close oversight is being kept of the radium cases, and we expect from time to time to give reports on all of these cases.

# JOHN G. CLARK

## THE RADICAL OPERATION FOR CARCINOMA OF CERVIX

Operative deaths (peritonitis) .....	5
Died from continuance in 3 months .....	1
Died from continuance in 6 months .....	3
Died from continuance in 10 months .....	1
Died from continuance in 11 months .....	1
Died from continuance in 12 months .....	3
Died from continuance in 15 months .....	1
Died from continuance in 16 months .....	1
Died from continuance in 18 months .....	5
Died from continuance in 2 years .....	6
Unable to trace .....	10
Alive and no sign of continuance:	
One year .....	2
One and one-half years .....	3
Three years .....	0
Four years .....	2
Five years .....	1
Six years .....	6
Seven years .....	1
Eight years .....	1
Total number of cases.....	53

## POST-OPERATIVE SEQUELÆ

Suppuration of abdominal incision .....	8
Cystitis .....	4
Peritonitis (recovery) .....	3
Ureteral fistulæ .....	2
Vesical fistulæ .....	5
Phlebitis .....	1
Laceration of rectum (fistula) .....	1
Pleurisy .....	2
Rectovaginal fistula .....	2
Average stay in hospital .....	21 days at least

## PANHYSTERECTOMY FOR CARCINOMA OF FUNDUS

Operative deaths (one patient died one week after operation from a general metastasis of chorioepithelioma. Death occurred from widespread involvement of the lungs with the malignant process. Other patient died from peritonitis) .....		2
Well over six years .....	5	
Well over five years .....	1	
Well over four years .....	1	
Well over three and one-half years .....	2	
Well over two and three-fourths years .....	2	

## RADIUM IN CANCER OF THE UTERUS

Well over two years .....	2
Well over one year .....	1
Died from continuance of disease in 3 months .....	1
Died from continuance of disease in 7 months .....	1
Died from continuance of disease in 1 year .....	1
Died from continuance of disease in 3 years .....	1
Died from continuance of disease in 5 years .....	2
Died in two and one-half years from mastoid abscess (complete autopsy revealed no microscopic trace of cancer either in pelvis or in the abdominal lymph glands) .....	1
Unable to trace .....	3
Total number of cases.....	26

### USE OF RADIUM IN INOPERABLE CANCER OF CERVIX, VAGINA AND URETHRA<sup>1</sup>

Deaths following treatment .....	0
Died from continuance in 1 month .....	4
Died from continuance in 2 months .....	1
Died from continuance in 3 months .....	1
Died from continuance in 4 months .....	1
Died from continuance in 6 months .....	1
Died from continuance in 7 months .....	1
Died from continuance in 8 months .....	1
Died from continuance in 9 months .....	1
Died from continuance in 10 months .....	1
Died from continuance in 11 months .....	1
Alive 22 months .....	2
Alive 21 months .....	1
Alive 16 months .....	1
Alive 14 months .....	1
Alive 12 months .....	2
Alive 11 months .....	1
Alive 10 months .....	1
Alive 9 months .....	1
Alive 7 months .....	5
Alive 6 months .....	2
Alive 5 months .....	1
Alive 4 months .....	5
Alive 3 months .....	4
Alive 2 months .....	15
Alive 1 month .....	4
Not traced .....	10
Total number of cases .....	69

<sup>1</sup> This table is a complete record of cases treated by radium up to the time of this paper going to print, September 15, 1916.



# JOHN G. CLARK

## HISTORY OF PATIENT AFTER APPLICATION OF RADIUM

Relief of hemorrhage (complete) .....	34
Recurrence of hemorrhage in 3 weeks .....	1
Recurrence of hemorrhage in 4 weeks .....	1
Recurrence of hemorrhage in 6 weeks .....	1
Recurrence of hemorrhage in 2 months .....	1
Recurrence of hemorrhage in 3 months .....	1
Recurrence of hemorrhage in 4 months .....	2
Recurrence of hemorrhage in 8 months .....	1
Relief of pain (complete) .....	2
Relief of pain for 2 months .....	1
No relief of pain .....	18
No symptomatic relief .....	12
Local healing of ulcerative area (of this number, 2 died subsequently of internal metastasis) .....	26
Rapid extension of growth, coincident vesicovaginal and rectovaginal fistuale .....	5
Immediate untowards result .....	0
Average stay in hospital—about 3 days.	

## THE FOUR-POST FRACTURE BEDSTEAD

BY JOSEPH MARSHALL FLINT, M.D.

OF NEW HAVEN

IN a recent article describing my experiences in France with the treatment of fractures by the combined use of suspension and extension (ANNALS OF SURGERY, June, 1916), attention was called to some old mediæval four-posted beds which I found in one of the hospitals adjacent to our own. They adapted themselves so conveniently in providing points of support for the suspension and extension of fractured extremities and proved to be so comfortable and useful that I felt that they should be copied and placed upon the American market. It may be of interest to know that identical beds which we employed in France were purchased over one hundred and fifty years ago, when patients were afforded a certain amount of privacy and protection from draughts by curtains attached to the iron frames.

A bed of this type possesses many advantages. In the first place, the frames that are formed above and around the patient provide points of support to which suspension and extension appliances may be attached in any position (Fig. 1), giving either support or pull in any desired direction. The method of treating fractures in this way is fairly complicated and can only be followed readily when the attachments for these supports are convenient and available. Accordingly, it seemed desirable to provide a bed with the ordinary attachments and accessories that were found useful in most of the cases that could be so treated. It consists of a four-posted bed provided with adjustable traverses above and fixed crossbars at the head and foot, so that suspension and extension appliances may be attached at will. The bed is mounted on rollers, making it possible to move the patient easily. It is also provided with the mediæval type of springs which consist of interlacing slats of spring steel so curved that, when the patient lies upon it, the curve compensates for the unequal weight of the trunk and extremities, permitting the patient to rest in a horizontal plane. It is obvious that we have here the effect given by a fracture board, without, however, the discomforts of the latter, inasmuch as the springs yield to the movements of the patient. The bed is equipped with an inclined overhead trolley for the treatment of fractures of the femur, as well as an extension pulley which can be placed at any point at the foot of

the bed for purposes of extension. Several types of overhead supports equipped with helical springs and pulleys serve for the attachment of the suspension appliances and counterweights. The hooks, rings, and supporting hammocks which we found useful are also shown (Fig. 2).

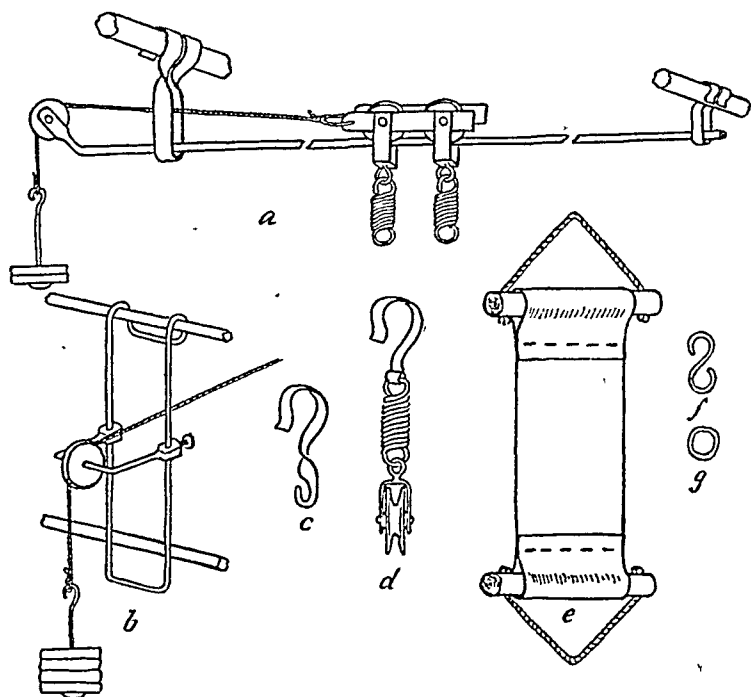


FIG. 2.—Details of the accessories. *a*, inclined trolley; *b*, extension pulley; *c*, hook; *d*, hook and pulley; *e*, hammock for support and the rotating mechanism; *f*, S-hook for making connections; *g*, ring for the attachment of ropes and hammocks.

It is unnecessary to go into detail at this time concerning the splints that can be used or the methods of treating fractures by this method. My own experience has been described in this Journal.<sup>1</sup> The article of Fauntleroy<sup>2</sup> on the appliances that have been devised and employed at the American Ambulance in Paris is worthy of careful study.

<sup>1</sup> Flint: ANNALS OF SURGERY, 1916.

<sup>2</sup> Fauntleroy: Report on the Medico-Military Aspects of the European War. Washington, 1915.

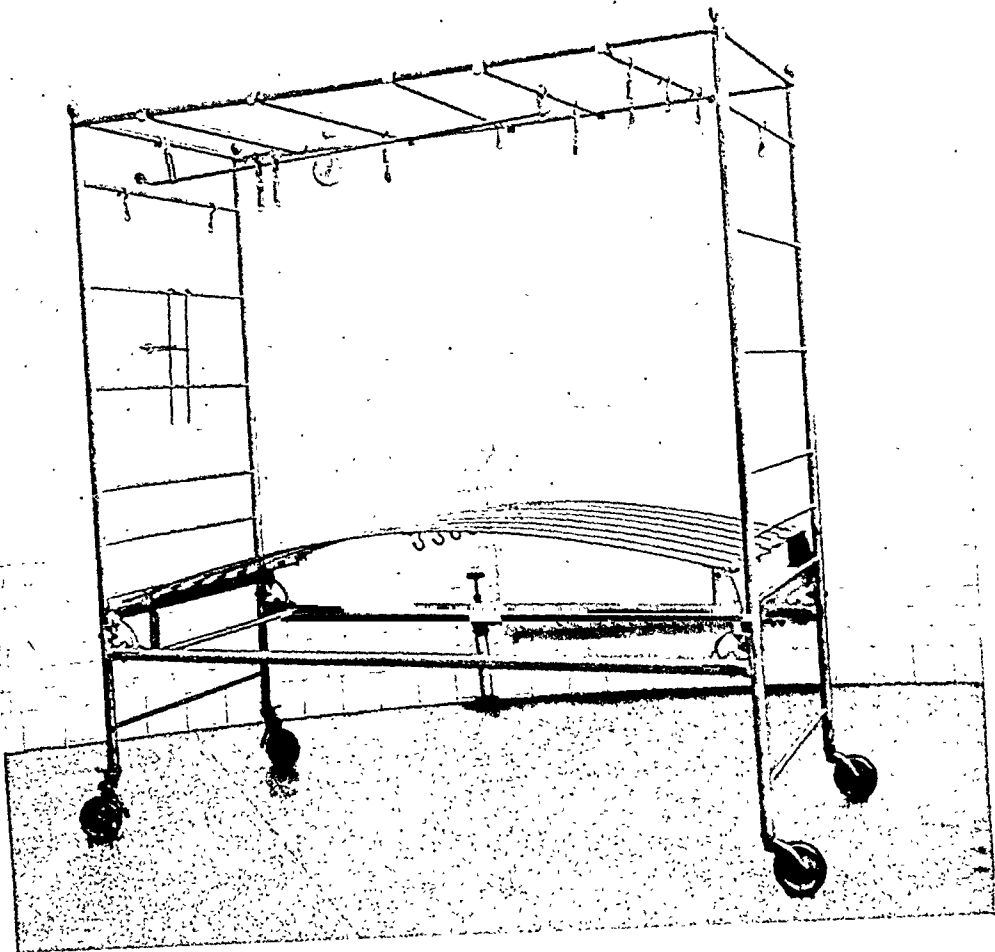


FIG. 1.—Fracture bed showing compensating springs, and the attachments for suspension and extension.



# SUPERNUMERARY MUSCLE OF THE DORSUM OF THE HAND

EXTENSOR BREVIS DIGITI MEDII ET INDICIS: A RARE CAUSE OF DISABILITY IN A PIANIST

BY DAMON B. PFEIFFER, M.D.

OF PHILADELPHIA

THE following case is reported not only because of its excessive rarity as an anatomical anomaly, but also because of its important practical bearing upon the occupation of the patient.

Mr. L. P., aged twenty-eight years, was referred to me by Dr. Vincent Lyon for an opinion as to the cause and treatment of a lump on the dorsum of his hand. The patient was a pianist and had been engaged in the study of this instrument for seventeen years. As long as ten years ago he had observed a small lump on the back of his right hand, which was situated in the angle between the extensor tendons of the index and middle fingers, its most prominent portion being about one inch below the level of the radiocarpal joint. This had increased gradually in size until at the time he was sent to me it was a quite conspicuous prominence when the fingers were held in extension. As he devoted himself more assiduously to practice, he observed that the lump would become quite sore after prolonged work, the soreness disappearing again after a period of rest. He noted also that the index and middle finger of the right hand seemed stiffer than the corresponding fingers of the left hand and, in fact, stiffer than any other two adjacent fingers of either hand, so that, in spite of the fact that he was right handed, it was more difficult to "trill" with these two fingers than with the others. For these reasons, which were serious because of the hindrance to his professional advancement, he sought relief.

On examination with the fingers flexed, there was a rather soft indefinable sense of fulness in the region indicated. Upon forced extension of the first or second fingers, or both, the prominence appeared and could be traced upward to where it seemed to blend with the annular ligament. It was tender to moderate pressure, which would give rise to an ache that lasted for a short time.

I attributed the condition to a synovitis involving the sheaths of the first and second extensor tendons and possibly affecting also the sheaths beneath the annular ligament. There was no evidence of previous local or general infection, but the patient

suggested the element of chronic trauma by saying that he ascribed the condition to playing in a forced and strained manner during his early practice. In view of the long series of recurrences upon exercise, with quiescence after rest, as well as the importance of bettering the condition, I concluded to lay bare the affected tissues in the hope of being able to resect inflamed or adherent structures. An X-ray taken previously showed that the bony structure of the hand presented no abnormalities.

*Operation.*—March 8, 1916, Presbyterian Hospital. A longitudinal incision was made directly over the mass. On opening the delicate deep fascia the structure of a muscle greeted my eyes. Its fleshy portion ran upward toward the annular ligament. Below, it sent off two tendons, the larger of which joined the radial aspect of the extensor tendon of the middle finger, while the smaller joined the ulnar aspect of the indicator tendon. Though there were two tendons there was apparently but one muscle belly. In view of the unexpected nature of the case, the lack of precedents in procedure, and the importance of doing nothing that might further impair the use of the fingers, after consultation with Dr. Lyon and cautious exploration of the muscle, the operation was terminated. Recovery was rapid and followed by a restoration to the former state.

The findings fully explain the nature of the case. A single-bellied extensor attached to two adjacent fingers would naturally interfere with the "trilling" movement, since extension of one finger would interfere with simultaneous flexion of the other and *vice versa*, though by the action of the more powerful long flexors and extensors the smaller muscle could be overpowered. The early stiffness and forced position to which he attributed the condition was rather a consequence than a cause of the anomaly, and the gradual increase in size was due to work hypertrophy of the muscle. Its antagonistic action, overpowered by stronger muscles, caused stiffness and soreness after exercise. It would seem justifiable, in the event of continued interference with function, to resect the muscle or perform tenotomy of the anomalous tendons, since the normal tendons were seen in their usual position and in a normal state of development.

In some respects this condition recalls the operation of Dr. Wm. S. Forbes,<sup>1</sup> first performed by him in 1857, which consisted in severing the accessory tendons of the ring finger in order to allow its extension unopposed by these bonds of union to the adjacent tendons. Mr. J. R. Zeckwer, whose interest in the subject is due particularly to the fact that his father was the first to advocate the procedure to musicians, states that some 10,000 operations of this kind were performed, with

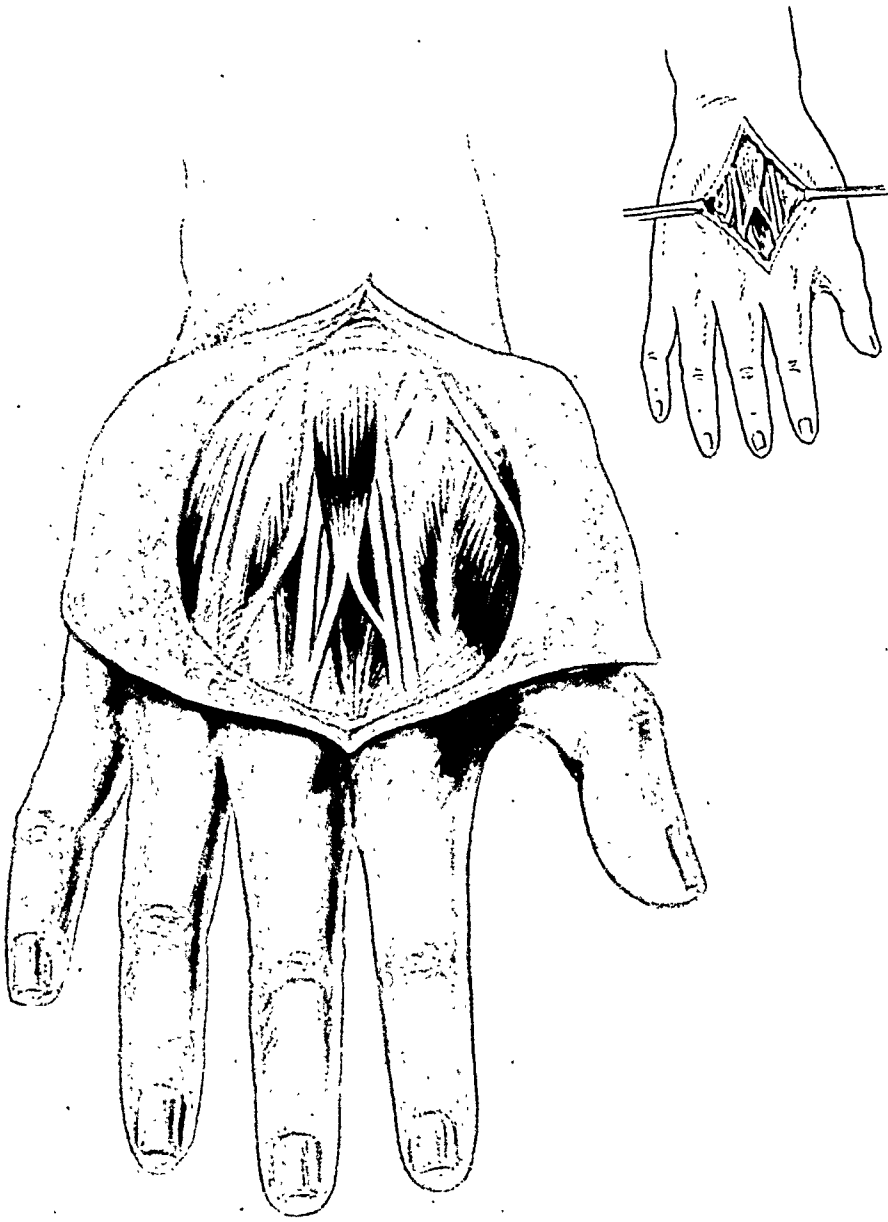


FIG. 1.—Extensor brevis medii digiti et indicis.





## SUPERNUMERARY MUSCLE OF HAND

brilliant results in certain cases. It is not now thought necessary, though in some instances where restriction is marked it can doubtless be used with benefit.

The present case is a very rare anomaly. The only reference to what is apparently an exactly similar condition is by Gruber,<sup>2</sup> who reports one such instance in 600 dissections (1200 arms). This muscle arose within the sheath of the fourth compartment of the dorsocarpal ligament and from the base of the third metacarpal. In the present case the exact origin was not ascertained, owing to a desire not to inflict unnecessary injury. The insertions of the tendons in the two cases were the same.

Anomalies of various kinds of the extensor muscles and tendons of the hands, however, are not uncommon. Albin,<sup>3</sup> in 1758, reported and pictured an instance somewhat similar to the above, which he named the extensor brevis digitorum manus, and Gruber<sup>4</sup> has recorded some sort of varieties of the short extensor of the hand in 1.417 per cent. of 1200 dissections of the arm and hand. Such muscles are vestigial structures, Owen<sup>5</sup> has pointed out that in the *Lemuridae* and *Quadrumana* "the homologue of the extensor indicis of man bifurcates, and sends a tendon both to the index and medius digit; the homologue of the extensor minimi digiti also splits and sends a tendon also to the annularis; so that while in man the index and minimus only have two extensor tendons, all four fingers have them in most *Quadrumana*."

Gruber<sup>6</sup> has shown that the *Orang Cynocephalus* and *Cebus apella* as a rule possess an extensor digiti indicis et medii, while MacAlister,<sup>7</sup> Humphrey,<sup>8</sup> and others have shown the normal existence of such short extensors of the digits in the unau, the ae, the two-toed ant-eater and the pangolin.

Ordinarily such variations would escape discovery. In the case reported it derived its importance from its bearing upon the occupation.

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# THE IMPORTANCE OF THE PROPER DOSAGE OF SODIUM CITRATE IN BLOOD TRANSFUSION

BY RICHARD LEWISOHN, M.D., F.A.C.S.

OF NEW YORK CITY

THE use of a minimal dosage (0.2 per cent.) of sodium citrate as a simplified method for blood transfusion<sup>1, 2</sup> has given rise to a considerable discussion in our medical literature. The discussion has been running in two directions, diametrically opposed to each other. On the one hand, it has been claimed that sodium citrate is such a toxic drug that its use in the human being, especially in cases of lowered vitality (which exists in all cases requiring transfusion), is an extremely risky procedure. On the other hand, the claim has been made that 0.2 per cent. is too small a dose to safely prevent coagulation during the transfer of the blood.

I have so far refrained from entering into any discussion on these points. I think, however, that sufficient clinical experience has now been accumulated, not only by myself but by a great number of colleagues in different parts of the country, to consider these objections and review them critically.

Let us first take up the question of the toxicity of sodium citrate. There can be no doubt that sodium citrate is very toxic when introduced in large quantities into a human being. It is by no means an indifferent drug like sodium chloride or bicarbonate of soda, which can be administered in very large doses without any injurious effect.

Citrate of soda has been the anticoagulant par excellence in laboratory work for a good many years. Why had it not been used until lately in human blood transfusion? The reason for this is very obvious. In laboratory work the proportion of sodium citrate used was 1 per cent. It was a generally accepted idea that the blood would clot unless this 1 per cent. mixture of citrate and blood was adhered to.

I have shown in a series of animal experiments (*l.c.*) that it would have been impossible to use a 1 per cent. mixture of blood and sodium citrate in human blood transfusion, especially when large quantities of blood are needed. If we want to substitute older methods by a newer one, this newer method, in order to be generally adopted, must answer all the requirements which the older method fulfilled. Many cases in which blood transfusion is indicated require large dosages. Lindeman<sup>3</sup> stated only recently, that he gives as much as 1500 to 1800 c.c. at one time to many of his patients with his syringe-

## SODIUM CITRATE IN BLOOD TRANSFUSION

cannula method. To give such quantities of blood mixed with 1 per cent. citrate would have been absolutely injurious to the patient. On the other hand, it is very obvious that the citrate method would have received scant consideration if we were obliged to limit its applicability to quantities of between 300 and 500 c.c., and if we were to face the possibility of serious injuries to our patients as soon as we would try to step outside of these very narrow limits. That my conclusions as to the toxicity of the 1 per cent. dose, though derived from a series of animal experiments only, hold good for the human being is very obvious from Brem's experience. Brem<sup>4</sup> administered 1 per cent. citrated blood, as suggested by Weil,<sup>5</sup> to nine patients, and came to the conclusion that "Weil's dose is toxic, dangerous and unnecessary."

For obvious reasons it is impossible to exactly fix the tolerance of the human body towards sodium citrate. I think, however, we can safely state that we can introduce 5 Gm. of sodium citrate into an adult without any risk of a toxic effect. The 0.2 per cent. dose, therefore, allows us to transfuse as much as 2500 c.c. of blood at a time, and that is more than anybody ever wants to take from a donor or introduce into the recipient. My experiences with citrate transfusion in children<sup>6</sup> are the best proof of the atoxicity of the citrate method and the 0.2 per cent. dose.

My personal experience with the citrate transfusion so far comprises 62 cases and 75 transfusions (the youngest patient being an infant ten days old). No sign of a toxic effect was observed in any of these cases. I have observed a chill following the transfusion in 10 per cent. of the cases. This percentage is absolutely identical with Lindeman's latest results (*l. c.*) (he formerly obtained nearly 30 per cent.<sup>7</sup>). If we do not get any more chills with the citrate method than Lindeman, who is using unmixed blood, gets, those chills can certainly not be caused by the mixture of the blood with an anticoagulant. I know from experience and observations of the older methods (vessel anastomosis, syringe method, etc.) that a certain percentage of chills will occur in any large series of transfusions, no matter what method is used. Furthermore, everybody familiar with transfusion work knows, that such a chill, usually not lasting more than a few minutes, does not interfere in any way with the clinical result of the transfusion.

We have had the good fortune to be able actually to compare the effects of citrated and unmixed blood. In a large series of cases which received repeated transfusions, two different methods were used at Mount Sinai Hospital—the citrate method and the Unger apparatus<sup>8</sup>—in order to compare the clinical results of citrated and uncitrated

blood. The citrated blood has in every instance proved clinically as beneficial as the unmixed blood. I have never seen a case in which any inferiority of the clinical value of citrated blood could be demonstrated.

It has been claimed by the opponents of the method (I think their number is rapidly decreasing) that citrate of soda might affect the microscopical elements of the blood (erythrocytes and leucocytes). I have repeatedly compared blood pictures of citrated and uncitrated blood. The citrated blood does not show any change from the normal blood picture. In fact, if one mixes up the different slides, it is impossible to say which were taken from the citrated blood.

I have consulted Dr. Ottenberg in reference to the question of a possible interference of sodium citrate with the biological activity of the leucocytes. He pointed out to me that in the Wright opsonic determination, in which the phagocytic activity of the leucocytes is to be measured, leucocytes are collected in a  $1\frac{1}{2}$  to 2 per cent. sodium citrate solution, which is ten times as strong as the percentage used in transfusion.

As to the second question—is a 0.2 per cent. mixture of sodium citrate and blood really sufficient to prevent coagulation of the blood? If one mixes blood with sodium citrate at the rate of 0.1 per cent., such citrated blood will clot just as quickly as normal blood. If one adds a minute amount of citrate (5 cgm. of citrate to 100 c.c. of blood), thus making the percentage 0.15 per cent., such mixture will stay fluid for at least two days. It would be perfectly feasible to use a 0.15 per cent. mixture for the citrate method of blood transfusion. Such a mixture, however, would have to be made very accurately. The slightest error under 0.15 per cent. would cause rapid coagulation. For this reason the 0.2 per cent. mixture was suggested.

The great majority of the reports profess perfect satisfaction with the 0.2 per cent. dose. Brem, for instance (*l. c.*), reports that he has carried citrated blood (0.2 per cent.) as far as seventy miles before he injected the mixture, and that this percentage has given him perfect satisfaction. On the other hand, there have been reports published, stating that danger of clotting was considerable when blood and citrate were mixed at the rate of 0.2 per cent. and that slightly larger doses were advisable (Garbat,<sup>9</sup> 0.25 per cent.<sup>3</sup>; Carter,<sup>10</sup> 0.3 per cent.).\*

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\* Agote (Buenos Ayres) sent me a few weeks ago a reprint of a paper entitled, "Nuevre procedimiento para la transfusión del sangre," published in the *Anales del Instituto modelo de clínica medica*, Buenos Ayres, January, 1915. It is interesting to note, that we both came to the same conclusions independently of each other. Agote's dose is 0.25 per cent.

## SODIUM CITRATE IN BLOOD TRANSFUSION

There is no objection to the use of a dose slightly larger than that originally recommended, as long as proper care is taken that the toxic level is not reached. On the other hand, a large clinical experience has shown that 0.2 per cent. is an absolutely safe percentage. Two considerations are of importance in connection with the question of the proper dose. It is very important that a large size needle be used when collecting the blood from the donor. The importance of this is obvious. Citrate and blood mix only after the blood has left the needle. The use of cannulæ with narrow lumen will not permit a free flow and the blood may clot before it mixes with the citrate solution. For the same reason care should be taken that the position of the cannula in the vein allows the blood to flow freely (Fig. 1).

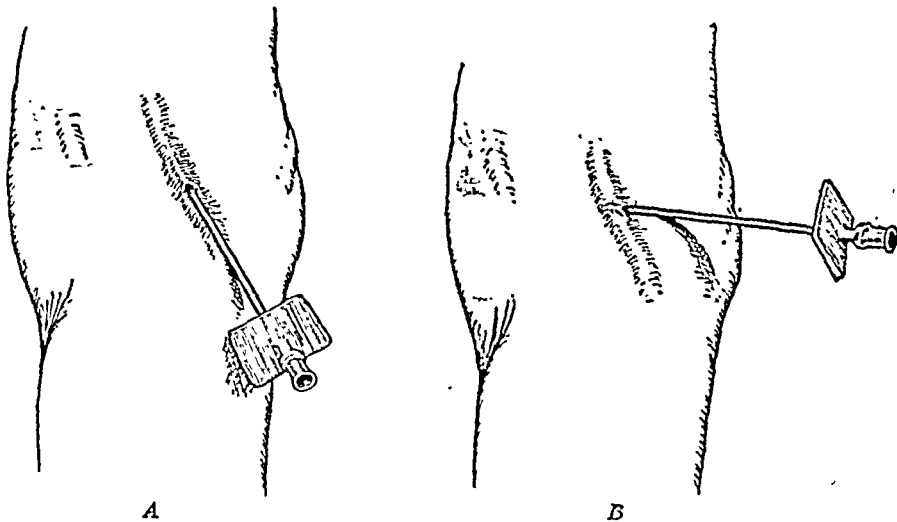


FIG. 1.—A, correct, B, faulty position of cannula in vein.

I have heard of some instances where the following mistake in figuring out the percentage was made. Two hundred cubic centimetres of blood were collected and mixed with 20 c.c. of 2 per cent. citrate solution. It is obvious that this represents a mixture below 0.2 per cent. The correct way to obtain the proper percentage would be to collect 180 c.c. of blood and mix this amount with 20 c.c. of the 2 per cent. stock solution.

I am sure that if these two points (proper position of cannula and proper mixture) are carefully considered, it will not be found necessary to increase the original dosage of 0.2 per cent., though 0.25 per cent. or even 0.3 per cent. can be used with perfect safety.

It seems hardly worth while discussing another argument, which has been advanced against this method. It has been stated that the 0.2 per cent. mixture, though possibly preventing coagulation of the

blood during the transfer, would not be sufficient to prevent formation of clots in the blood stream after its introduction into the recipient. In other words, it has been argued that the fixation of the minimal dose did not take into account the dilution in the blood stream of the recipient. This argument is so obviously without any scientific basis that it is not worth while dwelling on it for any length of time. It is obvious that all we have to do is to prevent coagulation during the transfer from donor to recipient. After the blood has once entered the circulation of the recipient, it does not need any anticoagulating drug; it then acts the same way as uncitrated blood.

Another important point might be discussed in this connection. How does the addition of an anticoagulant to the donor's blood affect the coagulation time of the recipient's blood? It might be argued theoretically, that the mixture of the blood with an anticoagulant might interfere with the coagulation time of the blood to such a degree that the citrate method would not be available in hemorrhagic diseases. The general applicability of the citrate method would thus be considerably curtailed. Weil (*l. c.*) has recorded the important observation that the coagulation time of the recipient's blood is shortened after the injection of citrated blood, and that the coagulation time of the recipient soon returns to its previous level. Ottenberg<sup>11</sup> has reported a most interesting study of the effects of a citrate transfusion on a hæmophiliac. After injection of 150 c. c. of citrated blood (0.2 per cent.) the coagulation time dropped within ten minutes from one hour and twenty minutes to seventeen minutes; after twenty-four hours the coagulation time had gone back to one hour and fifteen minutes and after nine days the coagulation time was one hour and thirty-five minutes. In other words, the coagulation time suddenly dropped most decidedly a very short time after a citrate transfusion and returned to its normal level within twenty-four hours. This observation tallies exactly with my findings.<sup>2</sup>

There is, however, a further observation in Dr. Ottenberg's paper, which, if confirmed, would represent a very important finding. Ottenberg injected 20 c.c. of a 3 per cent. citrate solution to patients. A sudden drop in the coagulation time occurred in the same manner referred to above. Forty-eight hours after the injection, however, the patient's coagulation time had nearly doubled (from one hour and thirty-five minutes to two hours and fifty minutes). It is impossible to draw any definite conclusions from this single observation in its present form. A possible objection to the conclusiveness of this experiment is the fact that pure citrate solution and not citrated blood was injected.

## SODIUM CITRATE IN BLOOD TRANSFUSION

In an actual citrate transfusion the anticoagulating power of the citrate is practically absorbed in the endeavor to prevent coagulation of the blood, whereas if we inject pure citrate solution into the body, the whole quantity of the citrate is at liberty to exert its anticoagulating power on the blood of the recipient, thus lengthening the coagulation time considerably.

Ottenberg's interesting observations certainly deserve further study. It is very difficult to take correct notes on coagulation time in hæmophilic and allied conditions. I agree with Ottenberg that only blood collected from the vein gives proper results. For obvious reasons it is hardly feasible to make thorough studies requiring frequent punctures of the veins of these patients. Practical experience certainly has shown in a large series of hemorrhagic diseases that the citrate method is just as beneficial as the transfusion of uncitrated blood. In fact, in cases of this kind where both methods were tried, the one has always proved as beneficial as the other.

I have grouped here together the more important arguments which have been brought forward against the application of the citrate method. It proves the real value of a new method that it can overcome in due time any objections which are thrown in its way. It is, however, a wrong principle to condemn the method, as has been done, on purely theoretical grounds. Anybody who still has theoretical objections should give the citrate method a thorough trial. I am sure that on this basis the citrate method will soon become the generally adopted method of blood transfusion, a position to which it is entitled on account of the utmost simplicity of technic and the perfect safety of its application.

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# TRANSACTIONS

## OF THE

### NEW YORK SURGICAL SOCIETY

*Stated Meeting, Held May 10, 1916*

The President, DR. CHARLES N. DOWD, in the Chair

#### INTUSSUSCEPTION IN ADULT

DR. RANSOM S. HOOKER presented a man, fifty-two years old, who was always well and strong, until one morning about a year and a half ago, when, on starting work, he began to have pain in his abdomen. This pain kept up all during the morning, but was not severe enough to prevent his keeping on with his work. After his lunch he suddenly had very acute abdominal pain, so severe he could not stand up, and he was taken to Bellevue Hospital about 3 P.M.; up to that time he had not vomited nor had his bowels moved. On reaching the hospital his temperature and blood were normal and his pulse 110. On examination his abdomen was rigid, somewhat distended, painful to pressure over all, and a mass was thought to have been felt in his right iliac region.

At operation, an incision was made through the right rectus and the abdominal cavity opened. There was considerable amount of bloody fluid and a large mass was found in the ileocæcal region, which was recognized as an intussusception. It was found impossible to reduce it, and, as part of the cæcum was necrotic, about two feet of the ileum and one foot of colon were resected and a side-to-side anastomosis made.

A thorough examination was made to ascertain the cause of the intussusception, but nothing was found except that the colon was very mobile. He made a perfect recovery and left the hospital in about three and a half weeks. His scar shows a firm wound with no signs of hernia.

Several times since his operation he has had attacks of acute abdominal pain. At each time he felt a lump, as he expressed it, which was about the size of a ball, but deep down, and by pressing on this lump it disappeared and the pain was immediately relieved.

## PERFORATED DUODENAL ULCER

### PERFORATED DUODENAL ULCER

DR. FRED. T. VAN BEUREN presented a man, aged thirty-five years, who was brought to the Volunteer Hospital on April 11, by the ambulance, at midnight. He had been working late at a bank and about 11 P.M. was suddenly seized with severe colicky pains in the epigastrium, accompanied by nausea and vomiting. The pains were so severe that an ambulance was summoned which brought him to the hospital, where he was put to bed on the Medical Service under expectant treatment. He had eaten nothing but crackers and milk for supper and had vomited repeatedly, but the pain persisted.

He said that his trouble began about two years ago, when he first began to have attacks of pain in the pit of the stomach. The pain was greatest to the right of median line, increased by outside pressure, and came on in irregular attacks with intervals when he was free from pain and discomfort. In such attacks, the pain usually made its appearance one to one and one-half hours after meals and lasted about two hours. Pain was more severe after eating meat and broths or hot soups. Occasionally he would vomit with the onset of pain. Vomitus is sour tasting and accompanied by burning sensation in the throat. He complained of having a good appetite but being afraid to eat on account of the pain. Eructation of gas follows the pain. He had noticed no blood in vomitus or stools.

When seen by the reporter, about seventeen hours after the onset of his attack, he looked exceedingly ill and was in evident, severe pain. His physical examination was negative, except for the abdomen, which was held tense and was rigid all over but especially in the right upper quadrant. Tenderness also was most marked here but extended over the entire abdomen and diaphragmatic respiration was decidedly limited. Liver and spleen could not be felt, but percussed normally and dulness could be elicited in the right but not in the left flank. No masses were felt. There was a trace of albumin and a few casts in the urine; temperature 102, pulse 100, respiration 28; no white blood-cell count had been made.

On opening the peritoneum, a considerable amount of cloudy fluid with some small particles of fibrin was forced out. This fluid had no odor and appeared to come chiefly from the right lumbar gutter. There were flakes of fibrin on the hepatic flexure of the colon and on the duodenum and all the intestines surrounding the area were reddened. A large fibrinous plaque, about 1 x 3 inches, covered part of the duodenum and the pyloric portion of the stomach and the right border of the great omentum. On raising the gall-bladder from the colon, to

which its fundus was adherent, the neck of the gall-bladder was lifted away from the adhesions binding it to the duodenum, and a ragged perforation about one-quarter inch in diameter was disclosed on the anterior wall, apparently of the duodenum; but as the pyloric vein could not be made out it is impossible to say definitely. From the perforation, gas and fluid issued. There was about two ounces of turbid fluid in the right lumbar gutter and a small amount in the pelvis. A careful examination of stomach and duodenum discovered no further ulcers. The peritoneal covering of intestines toward the left side of abdomen was apparently not involved.

*Procedure.*—An incision, six inches long, through outer border of right rectus muscle was made and retraction of the exposed edge of liver, gall-bladder and colon. Gauze was used to wall off the rest of abdominal cavity and the duodenum exposed by lifting up the liver and gall-bladder. A pack was placed over the perforation and the right lumbar gutter freed of fluid of aspiration.

A purse-string of fine chromic catgut with a fine curved needle was made to surround the perforation, and drawn tight, while the edges were inverted by an assistant. This closure was reinforced by a vertical running mattress suture of Pagenstecher, drawing anterior wall of duodenum against anterior wall of pylorus, and covered by fat tabs from lesser and greater omenta, drawn together across the suture line. When completed the repair seemed efficient. Its performance was difficult on account of the high position of the pylorus. After cleansing of the area all visible fluid was aspirated, pads removed and peritoneum and posterior sheaths closed by continuous catgut, anterior sheath by interrupted sutures of fine chromic and skin by silk. Dry dressing to binder.

He had a very smooth convalescence, not vomiting at all and having temperature normal on the sixth day, post-operative. His wound healed by primary union.

One point of interest was the extreme thirst he suffered during the first forty-eight hours, although he was retaining large amounts of fluid by rectum. It was then discovered that this was drachm to the pint saline, and when water by mouth and rectum were substituted for saline by rectum, his thirst was relieved. He has had no symptoms of gastric retention and no gastric or intestinal discomfort, except on the nineteenth to twentieth day, when an indiscretion in diet gave rise to moderate abdominal pain and diarrhoea. There was no sign of gross blood in the movements and a dose of castor oil with a return to soft diet for a few days relieved it.

## SPLENECTOMY FOR HÆMOLYTIC JAUNDICE

### SPLENECTOMY FOR HÆMOLYTIC JAUNDICE

DR. JAMES I. RUSSELL presented a young man, aged twenty years, who was admitted to the Medical Service of Roosevelt Hospital, from which he was transferred to the Second Surgical Service, July 6, 1915, suffering from hæmolytic jaundice with no symptoms other than occasional pains in upper right and left quadrants of the abdomen. His mother thinks he was a "little yellow" since birth, this became more marked at the age of five, from which time the jaundice has been practically of the same intensity. He feels perfectly well with the exception of an occasional dull ache in the upper abdomen. There is no itching of the skin, the stools and urine are normal in color. There has been no nausea, vomiting, weakness of crises such as accompany the acquired type of hæmolytic jaundice. His father and mother with six brothers and sisters are alive and well. There is no history of jaundice either in the immediate or remote relatives, though he tells me that those brothers and sisters who were born in Russia, as he was, are of darker skin than those born in this country. He is a well nourished young man, whose skin and conjunctivæ are distinctly jaundiced.

*Physical examination.*—Is negative except for a large spleen which extends four inches beyond the costal margin. The liver is not palpable. Upon admission temperature, pulse and respiration normal; weight 131 pounds; red blood-cells 5,216,000; H. B. 73 per cent.; white blood-cells 7600; polymorphonuclears 75 per cent.; basophiles 1 per cent.; lym phocytes 20 per cent.; large mononuclears 2 per cent.; transitionals 2 per cent.; anisocytosis; fragility, 0.45 per cent. saline, no hæmolysis; 0.4 per cent. saline, marked hæmolysis; 0.35 per cent. saline, complete hæmolysis. Vital stain 8 per cent. granular cells (reticulated reds). Wassermann negative. Urine negative. Blood culture negative.

Four days after admission to Surgical Service, he was given m. 10 adrenalin-chloride by hypodermic. Operation was performed a half hour later. Exploratory through the upper right rectus. Liver, gall-bladder and ducts appeared normal. Wound closed and a left upper rectus incision made. The spleen was very much enlarged, had contracted considerably (as demonstrated by surface markings) from the administration of the adrenalin-chloride. It was movable, there were but few adhesions, consequently but little bleeding, in delivering the spleen into the wound. The vessels were ligated individually and divided, the stump was then whipped over with catgut. The spleen weighed 1143 grammes (40). Temperature, which reached 102 on

the evening of the operation, reached normal on the fifth day and remained so throughout the convalescence, which was a smooth one.

Sixth day post operative: Red blood-cells 5,200,000; H. B. 85 per cent., an increase of 10 per cent.; white blood-cells 21,500; polymorphonuclears 83 per cent.; eosinophiles 4 per cent.; lymphocytes 13 per cent.; 18 normoblasts seen in counting 200 white blood-cells; anisocytosis, poecilocytosis, achromia slight.

Fifteen days after operation: Fragility, 0.4 per cent. saline no hæmolysis; 0.35 per cent. saline slight hæmolysis; 0.15 per cent. saline still a few red blood-cells.

Six weeks after operation, hæmolysis begins, 0.45 per cent.; complete 0.3 per cent. The auto-agglutination test was not done. We have not, however, found it at Roosevelt to be as constant as Widal found it; which test is positive in his work in the acquired type and negative in the familiar type.

He was discharged from the hospital three weeks after operation, the jaundice having almost completely disappeared, wounds healing primarily.

#### TUBERCULOSIS OF KIDNEY

DR. RUSSELL presented a boy, aged eleven years, who has always been frail and delicate. No definite pulmonary process has at any time been demonstrable. In August, 1915, he had a little bleeding at urination from time to time; some frequency, getting up two or three times during the night. This has continued up to the time of admission into the hospital. About two months before coming to the hospital he began to complain of pain in the right lumbar region. The right kidney is palpable and tender to pressure. There is no tenderness over the left kidney and it is not palpable. He remained in the hospital for two weeks, during which time daily examinations of 24-hour specimen revealed red blood-cells and pus in varying amounts, but tubercle bacilli could not be demonstrated in the mixed urine nor could they from the catheterized specimen from the ureters.

Cystoscoped by Dr. Kilbane of which the following is an abstract:

Some congestion, pus flakes, and velvety appearance of mucous membrane of post-lateral left wall of bladder above trigone.

Trigone and ureter orifices negative—catheters pass readily to either pelvis. Urine from right kidney, normal, clear, contains no pus nor blood; left kidney, rapid continuous flow of light colored turbid urine containing much pus.

## RADICAL OPERATION FOR CARCINOMA OF BREAST

Microscopical examination of the catheterized specimens showed red blood-cells and pus from left side and normal from right.

Guinea-pigs inoculation from the urine from the left kidney was normal.

Was discharged and readmitted a month later.

Cystoscopy revealed right kidney functioning normally; left kidney still discharging pus and blood. Tubercle bacilli were found in the urine from left side, as it was on four or five successive days thereafter in the mixed urine.

Left nephrectomy with removal of the ureter through an inter-muscular incision was done. The kidney showed no visible evidence of tuberculosis; the ureter was thickened in the upper part. Upon section of the kidney were two small cheesy areas of tuberculosis as proved by microscopical examination. Sections from the ureter also showed tuberculosis.

Convalescence was normal. Since the operation, 3 months ago, he has gained considerably in weight, has no more frequency or blood in urine, has been free from tubercle bacilli since soon after the operation.

This case was reported to emphasize the persistence with which one often has to pursue examinations to detect the tubercle bacilli, since they apparently only appear in showers from time to time. The pain was that of the renal reflex in which it was referred to the opposite side. The boy is unusually young for tuberculosis of the kidney. The advisability of removing the ureter at the primary operation, as this ureter showed tuberculosis, both macro- and microscopically.

## RADICAL OPERATION FOR CARCINOMA OF BREAST. (WITH THE STEWART INCISION.)

DR. BENJ. T. TILTON said that the chief interest in the case presented by him lies in the method of incision. The case is a scirrhus carcinoma of the breast operated on two weeks ago to-morrow. The main point of the incision which is recommended by Dr. Stewart of Philadelphia is that the incision lies entirely upon the body and does not come up on the arm as in the usual incision. This is a great advantage on account of the fact that there is no possibility of contraction of the axilla following and also the scar is much less prominent. The post-operative comfort is very much better. After the operation the patient is able to move the arm perfectly well; in fact, it has not

been included in the dressing at all, and is, therefore, very much more comfortable.

The incision starts from the middle line on a level with the nipple and circumscribes the upper limit of the breast, including all the skin of the breast. It ends posteriorly at the same level over the latissimus dorsi muscle. The exposure of the muscles above is all done and the axilla dissection before the lower incision is made.

After having completed the dissection of the axillary space, the incision is completed by circumscribing the breast below, including the entire skin. Both pectoral muscles are removed. At the outer end of the incision a drainage tube is inserted for forty-eight hours.

The edges come together with much less tension than usual and the resulting line of suture is very much less unsightly.

DR. JOHN F. ERDMAN said that since September 28 or 29 he had removed breasts twenty-two times, nineteen of which were done by the Stewart incision. His experience has not been as beautiful as Dr. Tilton's in regard to the question of comfort. Now in every one of these twenty-two operations he has had more pain than in the ordinary incision. Then there is another thing, there is absolute adhesion of the flap to the wall and there would be more of a pull on the transverse scar than in the perpendicular one. The retraction of the skin flap during the dissection of the axilla is relatively as easy as any other type of operation. The operation is not possible in all growths of the breast, that is, in all malignancies.

The two, of these twenty-two operations, in which the Stewart incision was not used were cancers or malignancies of the breast occupying the lower quadrant at the lower and outer segment of the breast and pretty thoroughly involved, so that one could not dissect a flap without a great deal of skin graft. In these he made the old ordinary flap.

In two instances he had considerable amount of pocketing in the lower flap, because he had not put in sufficient drainage. If one uses a quarter inch tube or an eighth of an inch tube for the first thirty-six hours, there is no question about the drainage.

Personally, he liked the operation very much.

DR. WIENER said that he had done the operation seven times since last July. The one strong characteristic of these cases was the lessened discomfort that these patients had. Another important advantage is the absence of swelling in the upper arm and forearm, which is so common with the old operation. This is almost absent in these cases. Also, there is no skin slough over the shoulder, which took five or six

## MAJOR SURGERY UNDER MINOR ANÆSTHESIA

weeks to heal. The transverse incision would occasionally give a small marginal necrosis but a very small one.

## MAJOR SURGERY UNDER MINOR ANÆSTHESIA

DR. JOS. WIENER read a paper with the above title, for which see page 589.

DR. S. C. MILLIKEN said that a year ago in April he saw Dr. Mitchell in Washington do a two-hour operation on an old fracture of the clavicle where the inner fragment was pressing on the brachial plexus and causing pain. This operation was on a man of about sixty-six years. He used what he said was one-tenth of one per cent. of cocaine with one to ten-thousandths adrenalin. Apparently there was no discomfort to the patient during that long and very tedious operation. It was very difficult to shell out the callus. He made a tongue and groove thing on the ends of the bones, and a very beautiful reduction. The procedure seemed very brilliant. Since then he had used that method in quite a number of cases.

In hernia cases it is a very nice procedure, but the only part that he had not been able to make painless is the exploration of the inner side of the abdomen. In feeling to see if there is a second sac or if there is any need to feel inside the patient, the patient always complains when the exploring finger comes down to the bladder in feeling into the pelvis.

In double operations the local anæsthetic should be resterilized after the first operation. He recently tried a double hernia at one sitting on an old man with a severe case of bronchitis. The left side was infected. Perhaps if they had resterilized the cocaine the infection might have been avoided.

A week ago last night a man came in with a ten days' intestinal obstruction. He had a large right hernia which was a recurrence, and was irreducible. He was continually hiccupping, his skin was cold and clammy and he had a very small pulse. The hernia was not entirely reducible, because the abdominal wall was so tense that contents could not be held back. An incision was made with the idea of finding out what was the trouble; running the hand into the pelvis there was found a carcinoma causing the obstruction about three inches above the pelvic floor, the small intestine was adherent to the carcinoma. The sigmoid was drawn out and drained. There was no pain except while the hand was exploring around in the pelvis. He died five days later of asthenia without any local complications.



DR. TILTON said that cocaine had practically had its day as a local anæsthetic in general surgery. Novocaine has great advantages, the chief one being this—the amount of novocaine that can be employed is practically unlimited.

First the use of novocaine in combination with general anæsthesia is most satisfactory in gall-bladder operations. The amount of ether necessary to get relaxation of the abdominal wall is very much less because of the anæsthetic effect of the novocaine on the parietal peritoneum. One can get along with gas and oxygen and practically no ether.

DR. KARL CONNELL said that local and other minor methods of anæsthesia for major surgery have done great service in developing the technic of operating. Minor anæsthesia has trained the surgeon in fast work, sharp cutting and the avoidance of traction and pressure on tissue. By competition it has undoubtedly improved the quality of general anæsthesia. It would be unkind to say that this has been the greatest service of local anæsthesia to major surgery. Yet, when one averages the results of the more dangerous methods, such as spinal nerve block, with those of efficient ether anæsthesia, there can be no question as to the average choice. Even local block anæsthesia, when applicable to major operations, has a value below that of general anæsthesia. When one considers the psychic strain on patient and on surgeon, the increased time and difficulty of operation, the systemic intoxication, and the operative sequelæ, such as pneumonia, that one occasionally encounters under local anæsthesia, the actual field for minor anæsthesia in major surgery is limited. Development in anæsthesia will take place along the line of more efficiently administered general anæsthetic, properly selected and graded in depth to block the centripetal stimuli of the operation in hand.

## BOOK REVIEWS

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TREATISE ON FRACTURES. By JOHN B. ROBERTS, A.M., M.D., and JAMES A. KELLY, A.M., M.D. With 909 illustrations, radiograms, drawings and photographs. Philadelphia and London: J. B. Lippincott Company, 1916.

As stated in the preface, the purpose of the authors of this work is to present a lucid view of the subject of fractures in the light of recent discoveries, to point out an accurate scientific procedure according to the character of individual injuries, and to urge the general practitioner, as well as the surgical specialist, to the study of methods, operative or non-operative, with augury of propitious result.

From a careful analysis of the pages of this volume, it may be vouchsafed that the authors have not only attained their purpose, but that they have also added to the literature of fractures a standard and authoritative guide embracing the results of vast practical experience, careful thought, sound judgment and the painstaking attention to details involved in the accurate recording of those observations which emphasize and clarify methods and results.

The arrangement of the text is simple and concise; there are twenty-nine chapters in all, the first of which is most comprehensive and devoted to so-called general considerations. In this are included statistics, etiology, the varieties and classification of fractures, symptomatology, and diagnosis, together with some observations on the value and function of the X-ray. The same chapter includes the process of fracture repair, delayed, vicious and non-union, the complications of fractures, a description of epiphysial separations, and a comparison of the results of non-operative and operative treatment. In the same section are well described the various methods of reduction and immobilization, together with the many varieties of retention and traction apparatus and the indications for their use.

Chapter II is given to a consideration of the operative treatment of closed fractures. In this are clearly set forth the indications for and against open interference and the technic of operative repair with and without internal fixation. The several mechanical appliances for

retaining the fragments in proper position are fully discussed with special detailed reference to the metallic plates of Lane and Sherman and the living bone graft.

Beginning with fractures of the cranium, the various regions of the body are next considered in their proper order. This regional presentation of the subject comprises twenty-five chapters, in each of which are accurately recorded statistics, etiology, surgical anatomy and the several factors pertinent to diagnosis and appropriate methods of treatment.

The volume is concluded with sections given to the consideration of birth and gun-shot fractures.

The illustrations are excellent and abundant. Many photographs, skiagrams and anatomic drawings, over nine hundred in number, serve to emphasize every phase of the subject. A complete index is appended. A study of these pages is both profitable and a pleasure. The teachings are sound, modern, practical and conservative. We commend it not only to the student and general practitioner, but also to the hospital surgeon who aspires to give his fracture patients results which are better and possible of attainment in shorter periods of time than they have been in the past.

WALTER A. SHERWOOD.

A TEXT-BOOK OF FRACTURES AND DISLOCATIONS, WITH SPECIAL REFERENCE TO THEIR PATHOLOGY, DIAGNOSIS AND TREATMENT. By KELLOGG SPEED, M.D., Attending Surgeon, Cook County and Provident Hospitals, Chicago, Ill. Octavo, 888 pages, with 656 engravings. Philadelphia and New York: Lea & Febiger, 1916.

Within the past year American surgeons have made notable and valuable contributions to the literature of fractures and the surgical affections of bones and joints in general. The new works of Roberts and Kelly, of Preston, Albee and a revised edition of Scudder, together with the volume under present consideration, all bear striking evidence of the increased interest which has been aroused and the progress made in this important branch of the science of surgery.

In the preparation of this work, while the author has made use of the literature on the subject of fractures and dislocations, much of the clinical and all of the statistical material has been obtained from the records of the Cook County Hospital, Chicago, where opportunity has been afforded for the observation and study of many thousands of cases.

The arrangement of the text comprises twenty-eight chapters. The first three sections are especially noteworthy; they are given to a consideration of bone regeneration and transplantation, the etiology and general mechanism of fractures and their pathology, a basic knowledge of which is just as essential for proper interpretation and treatment as in any other field of medical or surgical science.

Separate chapters are given to the general considerations of both fractures and dislocations; in their regional arrangement, however, the dislocations are discussed with fractures according to the bone or joint involved.

The operative treatment of open and closed fractures is fully and ably presented. The discussion of the methods of reduction, extension and immobilization is excellent.

The text is profusely illustrated with reproductions of photographs and line drawings. The latter are made from careful tracings of röntgenograms, each of which represents an actual case.

The work as a whole is complete and in thorough accord with the best modern teaching. Its pages contain many original ideas and suggestions.

WALTER A. SHERWOOD.

DISEASES OF THE NOSE AND THROAT, COMPRISING AFFECTIONS OF THE TRACHEA AND ŒSOPHAGUS. A Text-book for Students and Practitioners. By SIR ST. CLAIR THOMSON, M.D. Second Edition, with 22 plates and 337 figures in the text. Cassell and Company, Ltd., London, New York, Toronto and Melbourne, 1916. Roy., 8vo. pp. XVI. 858.

The author first presents a short chapter on the embryology and physiology of the nose and throat, with general remarks on methods of examination, general symptoms and treatment and the unusual conditions, as well as the usual ones, affecting the risk of operative treatment. One hundred and fifty pages are given to general and special considerations, including the symptoms and treatment, of the diseases of the nose. The same amount of space is devoted to the accessory sinuses of the nose. Then follows a short chapter on hypertrophy of the nasopharyngeal tonsil, tumors of the nasopharynx and postnasal catarrh. One hundred pages are given to the consideration of the numerous affections of the oropharynx and the tonsils, both acute and chronic. A similar space is devoted to diseases of the larynx. Twenty pages are given to diseases of the trachea and œsophagus. A special chapter on

the chronic infective diseases (lupus, tuberculosis, syphilis, glanders, leprosy, sclerosis and actinomycosis) of the upper air-passages fills a hundred pages. The manifestations of the acute specific fevers (measles, scarlatina, variola, varicella, pertussis, typhoid, influenza and diphtheria), occupy about twenty-five pages. The next part of the book is devoted to some general affections of the nose and throat, including gout, rheumatism, myxœdema, acromegaly, angio-neurotic œdema, herpes, pemphigus, exudative erythema, foreign bodies in the air and food passages, median cervical cysts and fistulæ and mimicry of disease. The next and final part of the book describes some of the more extensive and radical operative procedures on the nose and larynx. Formulæ and an exhaustive index complete the book.

It will be seen by the scope of the work which the above summary of its contents is intended to exhibit, that this is a thoroughgoing treatise in which the field covered by the title has been thoroughly worked out. The reviewer would be pleased if he could give some idea of the author's style which carries much in comparatively few words and conveys to the reader the earnest convictions of the writer from an evidently wide clinical experience and enthusiastic study of the literature of the subject. Very little of importance has been passed by without some, and usually helpful, comment. While not encyclopædic, the book is inclusive and satisfying.

WILLIAM C. BRAISLIN.

DISEASES OF THE SPINAL CORD AND ITS MEMBRANES. By CHARLES A. ELSBERG. Saunders Co. 8vo. pp. 330.

DR. Elsberg's work is noticeably free from the atmosphere of "compilation" which forms a distinct halo around so many works in medicine and surgery. This recent contribution to the surgery of the spinal region presents a striking contrast, in that it is largely made up of the author's actual experiences in the various conditions portrayed; from inspection and diagnosis, through operation and post-operative treatment until the patient is discharged, thus giving it a unique value. As it correctly states in the preface, those underlying principles which have stood the test of time are incorporated, as in any science, the fundamental facts already demonstrated are always employed in widening our horizon toward bigger basic truths. However, the work in question distinguishes itself not only in its particular field but as a type of surgical writing, the style of which is indeed none too apparent at the present time.

The book must be commended for its practical size and lack of great bulk making it convenient for both student and practitioner and for the

absence in its text of superfluous, extraneous and irrelevant material. Particular note should be made of the logical order of arrangement of the various chapters and the admirable system of indexing, which is clear, concise and time saving. The illustrations are especially valuable on account of their anatomic and pathologic accuracy, their generous variety and the many excellent roentgenograms included.

It fills a long-felt need in neurologic surgery for competent and constructive work in this field.

The book is divided into three parts with each division complete in its particular phase covered, thus making an important reference for any particular branch of the subject when a complete survey is not desired.

*Part I.*—Incorporates the surgical anatomy of the vertebral column and the spinal cord, the normal and pathological physiology of the spinal cord, the localization of motor, sensory and reflex functions in the different segments, symptomatology of spinal disease, the symptoms of spinal disease at different levels of the cord, methods of examination, the use of the X-ray here and the differential diagnosis of surgical spinal lesions.

In taking up the anatomy of the vertebral column a complete résumé is not attempted, the author merely refreshes some more prominent facts and emphasizes the salient points of the osseous and muscular coverings of the cord from the surgical side.

The membranes of the cord are briefly discussed with respect to their anatomical relation to the cord and nerve roots, their formation of surgical landmarks, and the importance of the subarachnoid space as a cistern for cerebrospinal fluid.

The surgical value of a thorough knowledge of the anatomic variations in the relation between cord and vertebræ at different levels of the spine, is clearly and briefly stated. In touching on the blood supply and main fiber tracts of the cord, the vessels are covered in a general way to emphasize the high vascularity of this region and to indicate certain incisions of choice when working near them.

A very practical table of the main fibre tracts is represented.

The physiology of the cord serves to refresh and summarize those facts of primary importance which must always be in play when considering spinal lesions from any standpoint.

Variations in symptoms are explained with respect to changes in anatomy at different levels as well as results following partial and complete damage to various structures involved.

Highly interesting observations have been made by the author concerning the sensitiveness of the cord and its coverings. This section embraces a table explaining the segmentary localization of the muscles

with their functions included and must necessarily be mastered by any one attempting to correctly interpret abnormalities of those functions when due to spinal origin.

In recording the symptomatology of various lesions a careful analysis has been made to show the points of contrast between those of intramedullary and those of extramedullary origin, and stress is placed upon a proper recognition of the *sequence* of symptoms in order that a wise judgment may be formed when finally summing up a given condition.

With completeness and system a chapter describes the method of examination followed by the author, including a timely reminder that it is only by careful, thorough and repeated examinations that a correct diagnosis can be made and the exact localization of a spinal lesion be determined and the advisability of taking nothing for granted.

In the chapter on Roentgen-ray, the importance of this procedure is emphasized for every patient before operative intervention, not only to substantiate but in many instances to aid in ruling out a particular condition, and, further, it is wisely cited that the roentgenogram will in a large number of patients reveal the nature of the process which is causing the spinal symptoms and will offer information which may contraindicate operation, while in others the picture makes it imperative. To correctly read the findings in these X-rays, the well-known fact is repeated that the observer must have had considerable experience, including a study of the normal vertebral column.

*Part I* concludes by summarizing the main points concerning differential diagnosis, not only between lesions of cerebral and spinal origin, but also those which may be successfully relieved by surgery and the other class which by their nature, extent and location, makes any thought of operation an absurdity. A point noted and never to be lost sight of is the fact that a patient may have more than one condition of the spine at the same time, most frequently a luetic condition associated with some other process; tumor or what not.

*Part II* first treats of lumbar puncture and makes it clear that this operation is in no sense a formidable procedure and should in the rarest instances be attended by untoward results if a few fundamental principles governing the technic are observed. The wide and important range of conditions in which this may and should be advantageously employed has not had sufficient emphasis during recent years. This chapter is complete and should give any reliable man confidence to resort to the operation whenever indication arises.

The relative merits of hemi and complete laminectomy are discussed by Dr. Elsberg with the result that the complete operation is much

## BOOK REVIEWS

to be preferred and the doubtful benefits of the hemi laminectomy exist only when no exploration is necessary and when the operator wishes to divide nerve roots on but one side. The detailed technic of the author's method of laminectomy is given, including position of patient, anæsthesia, preparation and sterilization of operative field, and removal of bone until cord is exposed.

The special instruments adapted to this work are not only mentioned as each step is described, but they are also pictured, making the various stages of exposure much easier to comprehend and more readily visualized as one digests the text.

The possible dangers in different regions and the best plan of meeting these exigencies when they arise are clearly set forth.

Rhizotomy is broadly presented and after a careful analysis of the experience at large as well as his own, the author impresses the fact that it is not to be carried out for all classes of root pains, as a general panacea, but in selected patients only, and with the judgment based on a wide experience as the proper criterion for decision. A brief review including technic is made of the comparatively new operation of division of the antero-lateral tracts for pain relief. The author concludes that further experience must prove its usefulness as well as its limitations. The method of aspiration and incision of the cord is also given here.

A general consideration of the contraindications as well as the indications for laminectomy is given due emphasis. It is succinctly pointed out that the dangers should be relatively very slight when the operation is performed by the surgeon experienced in this line of work.

While the various forms of spina bifida have not in the main been attended by particularly brilliant results surgically, a section devoted to this unfortunate malformation may stimulate others to investigate and advance our present knowledge of the subject.

The material on abnormalities and diseases of the spinal vessels is graphically supplemented by the artist's drawings and the essential points in correctly recognizing and differentiating these vascular conditions are given.

One of the most important chapters of this work is that pertaining to injuries of the vertebræ, cord and nerve roots, because it is this class of traumatic spinal conditions which is most commonly encountered by the general surgeon.

The section on tumors of the vertebral column, spinal cord and membranes is covered with the thoroughness to which this part of the work is properly entitled; including many splendid illustrations demon-



strating operative procedures involving them and showing the particular lesions at different levels of the cord.

Other pathologic conditions here considered are, inflammatory processes of the membranes, abscess of the cord, spinal complications of Pott's disease and other less common diseases of the vertebral column, making the book as complete as it is practical.

It is a guide that should prove valuable to both physician and surgeon and surely would be a distinct asset to every medical library.

HORACE G. DUNHAM.

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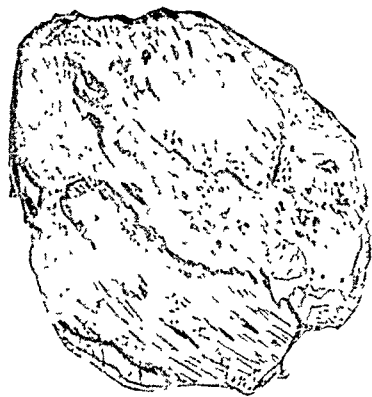
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The first (light colored) specimen is a cross-section of a strand of plain Kalmerid catgut, highly magnified.

The second (dark colored) specimen is a cross-section of the same strand, reacted upon by ammonium sulphid to precipitate the mercuric element. The uniform color throughout the section shows the thorough permeation by the Kalmerid (potassium mercuric iodid). Such an equable distribution of the Kalmerid assures a supply of this germicidal substance in the tissues until the suture is entirely absorbed.

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## TISSUE FRAGMENTS AND WOUND INFECTION

BY KENNETH TAYLOR, M.D.

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IN the course of injury by the missiles utilized in the present war, a wound may be left containing several kinds of foreign body. There may remain, first, the missile itself; second, fragments of clothing; thirdly, detached or severely traumatized tissue fragments. Such danger as there may be from the presence of the missile itself depends on its position, its shape and size, and especially its sharp edges, for on this depends the local tissue erosion which may result in serious hemorrhage or other damage to the structures in the immediate neighborhood of the missile. On its size and irregularities depends also to a large extent the number of bacteria with which it is charged and from which a focus of infection may arise. The danger from the shreds and fragments of clothing distributed along the track of the missile depends only on the load of bacteria which they contain. The danger from the fragments of detached tissue in the wound lies in the ready-made medium for bacterial growth which they constitute. Thus the injury has usually supplied two factors favoring infection: the supply of devitalized tissue for culture medium and the inoculation with bacteria.

The importance of removing the missile and the cloth is well recognized, but sufficient attention is rarely directed to the removal of the tissue, which is a hotbed for the initial incubation and multiplication of the bacteria.

With a view to determining the relative importance of a foreign body and of dead tissue in the initiation and rate of extension of infection in wounds, the following experiments were undertaken.

*Technic.*—The technic used for inoculation was the same for each of the experiments. The animals were anæsthetized, the operative fields shaved and painted with iodine, incisions made in the skin and muscle fascia and the implantations and inoculations made through a sterile glass tube inserted into the muscle

## KENNETH TAYLOR

mass. The wounds were then closed by one suture through the muscle fascia and another through the skin. The skin wounds usually healed promptly. Discs  $\frac{1}{2}$  cm. in diameter, stamped out of previously sterilized soldiers' cloth, were used as the type of foreign body for the implantations. For the tissue fragments pieces of muscle, excised from the wound and cut out as nearly as possible the size of the cloth discs, were used. They were handled and reinserted with aseptic precautions. One drop of a broth culture of the different organisms was the dosage employed in each inoculation.

Whenever possible comparative experiments were made in the same animal in order to reduce the factor of individual variation in the reaction and infection.

*Experiment 1. Tetanus.*—Nine guinea-pigs were anæsthetized, and an incision made in the skin and muscle of the right thigh. Into each was inserted, through a sterile glass tube, a fragment of cloth which had been previously smeared with an emulsion of garden soil (proved to contain tetanus bacilli and other organisms) and dried. One animal died of tetanus four days after inoculation. All the others developed a moderate inflammatory reaction resulting in a small abscess formation. Six other guinea-pigs were inoculated in the same manner with the same infected cloth, and simultaneously a piece of muscle about the size of the cloth was excised and reinserted with it. Three of these animals died of tetanus on the third day, the other three on the fourth. In all six a very acute and extensive inflammatory reaction resulted from the inoculation. The addition of the fragment of muscle tissue appears to be the only factor to account for the difference between the reactions in the two series of animals.

*Experiment 2. Staphylococcus aureus.*—Three guinea-pigs were anæsthetized. Into the right thigh of each was inserted first the fragment of muscle, then one drop of the bacterial emulsion, and finally the cloth disc; into the left thigh bacterial emulsion followed by cloth; into the right lumbar muscles a piece of sterile cloth alone; and into the left lumbar muscles one drop of bacterial culture alone. After forty-eight hours the right thigh of all three showed extensive palpable induration. The left thighs did not appear to be swollen. No reaction was evident over the right lumbar muscles, but there appeared to be a slight degree of swelling about the wound in the left lumbar muscles. All the skin wounds appeared to be clean and dry, and the skin united. On the fifth day the animals were killed, hardened entire in formalin, and subsequently dissected. In all three cases the right thighs showed large irregular abscess cavities from 1 to 3 cm. in diameter within the muscles and enclosing the cloth. The left thighs of all three showed small cavities firmly enclosing the cloth and slight diffuse inflammatory reactions throughout the neighboring portions of muscle, which had not, however, proceeded to abscess formation. In all three the fragment of cloth implanted in the right lumbar muscles was firmly embedded. The tissues surrounding showed no other evidence of inflammatory reaction. In all three cases the left lumbar muscles showed a limited area of infiltration but no abscesses. Results:

(1) The presence of a piece of sterile cloth produced no reaction beyond its fixation in the tissues.

(2) The presence of cloth in conjunction with *Staphylococcus aureus* produced much more extensive involvement of the tissues than inoculation with a similar amount of the same infective agent without a foreign body.

(3) The presence of the additional factor of dead tissue produced a still

## TISSUE FRAGMENTS AND WOUND INFECTION

more extensive and *much more rapid* infective process, resulting in an earlier abscess formation.

*Experiment 3. B. aerogenes capsulatus.*—Three guinea-pigs were anesthetized and the previous experiment repeated in exactly the same manner, using a twenty-four-hour dextrose broth culture of the *B. aerogenes capsulatus*. In addition to the four inoculations practised in that experiment, a piece of sterile muscle alone was inserted into the muscles of the right foreleg and a piece of sterile muscle together with one drop of the bacterial emulsion inserted in the muscles of the left foreleg. After twenty-four hours both the left and right thighs and the left foreleg of all three were swollen. In each case the right thigh was much larger than the left. The other wounds showed no reaction. The animals were killed on the third day, hardened as in the first experiment, and dissected. All three cases showed abscess cavities varying from 1 to 1½ cm. diameter in the right thigh. In addition there was considerable suppuration between the muscle bundles and a purulent extension along the muscle sheaths. The left thighs showed no abscess cavities in any of the three animals, but a varying amount of purulent infiltration which had not reached the stage of abscess formation. The sterile cloth implanted without inoculation was firmly embedded and there was no evidence of other inflammatory reaction about it in any of the animals. The wound containing bacteria alone showed in each case a very small area of purulent infiltration about the wound. The right forelegs, in which sterile muscle alone had been implanted, showed in one case a secondary infection of the wound and in the other two no reaction beyond some hemorrhage—probably operative. The left forelegs showed in two cases extensive purulent induration of the tissues about the infected fragments of dead muscle with some evidence of gas, and in the third case numerous small abscesses 2 to 3 mm. in diameter as well as considerable subcutaneous hemorrhagic exudate in the region of the wound. Thus the results of this experiment were parallel to those of the experiment with staphylococcus, and seemed to indicate that in the presence of infection by the *B. aerogenes capsulatus* the presence of dead muscle tissue was the most active contributory cause of a rapid extensive inflammatory process.

*Experiment 4.*—A further experiment was performed, using the same operative technic, with streptococci for the infective agent. Two animals were used. In the right thigh of each was inserted a fragment of muscle, then one drop of a forty-eight hour broth culture of streptococcus, which in turn was followed by a piece of sterile cloth. In the left thigh was inserted one drop of the same bacterial emulsion followed by a piece of excised muscle. In the right lumbar muscles was inserted one drop of the same emulsion followed by a fragment of sterile cloth; and in the left lumbar muscles one drop of the bacterial emulsion alone. Four days later both animals showed a thin milky discharge from right and left thighs and some induration about the wound in the right lumbar muscles. The wound in the left lumbar muscles showed no reaction. Four days later the wounds again appeared to be closed, the animals were killed, and the parts involved hardened in formol and dissected. In one the right thigh showed a small abscess containing the cloth and one or two drops of thin creamy pus. In the other the right thigh showed the cloth embedded in the muscle with purulent infiltration of the muscle tissue surrounding it. The left thighs were about equal in size to the right in both cases, and both showed a small fistulous tract extending

from the external wound to a small local area of infiltration and necrosis of muscle tissue. The right lumbar muscles in both cases showed the cloth firmly embedded in the muscles with no evidence of inflammatory process except a very slight induration about the cloth. The left lumbar muscles showed no signs of inflammation.

The results of this experiment resemble strongly those of the preceding ones. In the case of both these animals the most prominent inflammatory reactions were associated with wounds containing dead muscle tissue. The wounds containing infected cloth alone produced a comparatively mild reaction, while those containing infected cloth and muscle or infected muscle alone produced fairly extensive macroscopic lesions. The inoculation of the streptococcus alone into the uninjured tissue produced no obvious damage.

*Summary.*—From these four experiments the following facts may be restated:

1. The implantation of a sterile foreign body or a small piece of sterile dead muscle alone produced no macroscopic lesions.

2. The implantation of a foreign body infected with tetanus bacilli, *Staphylococcus aureus*, *B. aërogenes capsulatus*, or streptococci produced usually a localized abscess formation without invading the surrounding normal tissues.

3. The addition of a small portion of dead muscle tissue in the region of the infection produced a *more rapid* and *diffuse* inflammatory process with earlier and more extensive abscess formation than the wounds containing only bacteria or those containing infected cloth.

4. The implantation of infected cloth together with muscle tissue produced a more active and destructive lesion than the implantation of either alone. When infected with tetanus bacilli the presence of dead muscle fragments determined a high mortality.

5. Of the two substances, cloth and devitalized muscle, in the presence of infection, the muscle produced the more acute infective process.

*CONCLUSION.*—The result of these experiments suggests that in the cleaning of fresh wounds at least as much care should be exercised to remove separated and devitalized fragments of soft tissue as is taken to remove other foreign bodies.

In all operative procedures where blunt dissection is practised it should be remembered that torn fragments of devitalized tissue may remain to become a ready soil for the incubation of any bacteria which may gain access to the wound.

# BLOOD-PRESSURE AND GRAPHIC VASOMOTOR CHANGES IN THE PERIPHERY DURING ETHER ANÆSTHESIA\*

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IN a former paper <sup>1</sup> were set forth the results of a number of experiments on animals to determine and demonstrate graphically the changing conditions of the peripheral vessels during shock brought on by intestinal trauma.

The animals used were anæsthetized with ether, and the question naturally arises as to what depressing, exciting or neutralizing effect the anæsthetic may have had on the vasomotor mechanism.

The great importance of the general physiological effect of ether on the human organism, and the dangers connected with its use, have stimulated scores of physiologists and clinicians to experiment and observe. These investigators have attacked the problem from almost every angle, and as a result we have a great mass of observations, corroborating and disagreeing with each other.

*The Question of Blood-Pressure.*—As to the state of the blood-pressure during short or long-continued anæsthesia with ether, the consensus of writers seems to be that in the first stage of anæsthesia there is a sharp rise of blood-pressure. Verworn <sup>2</sup>, speaking of anæsthetics and the wide-spread relation between excitation and depression, says: "It appears to be a general property of these (anæsthetic) substances that in very small doses or with very brief administration they produce the phenomena of excitation . . . ." The observation that there is a rise of blood-pressure at first also agrees very well with the noted phenomena of the excitement during the first stage of anæsthesia by ether. Patton <sup>3</sup>, after summing up the conclusions of other workers, says that a stimulation of the circulation is generally noted by observers. Kemp <sup>4</sup>, in his experiments on animals, showed a rise in general arterial pressure. MacWilliam <sup>5</sup>, on the other hand, claims there is a general but slight fall in arterial pressure.

Observers also concur in statements that in long-continued ether anæsthesia there is a decided fall in blood-pressure. This phenomenon is well in accord with the observed action of increasing doses of anæsthetics on the individual cells of the organism, as shown by Verworn.<sup>2</sup>

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\*These experiments were completed in December, 1915.



He says that after the initial phenomena of excitation from small doses, and after brief administration, with increasing action of the anæsthetic, there are phenomena of depression, becoming more and more noticeable, which, apparently, are able to lead to a complete stand-still of life. Lyman<sup>6</sup> says that in consequence of certain factors to be named later, "the vascular pressure in the arteries, which may have exhibited an increase at the outset of inhalation, displays a decided fall. This diminution is much less noticeable when ether is used in place of chloroform." Potter<sup>7</sup> admits that if ether be administered long enough, after the cerebral functions are suspended, the lower centres in the medulla, carrying on the processes of respiration and circulation, are paralyzed. Gwathmey<sup>8</sup> says there is slowing of the pulse and a slight fall of blood-pressure during the later stages of anæsthesia, or when toxic amounts are administered.

While there is general agreement as to the status of the blood-pressure in the later stages of anæsthesia, it is certainly possible, with proper administration of the drug, to maintain deep anæsthesia for certain periods without the usual concomitant phenomenon, *i.e.*, lowering of blood-pressure. Meyer and Gottlieb<sup>9</sup> say that general observations on animals show that "when ether is used the blood-pressure may long remain at normal level." After summing up the conclusions of workers on this subject, an editorial in the *Journal of the American Medical Association*<sup>10</sup> concludes by saying, "It is well known that ether, when administered properly for a moderate length of time, does not lower the blood-pressure." . . . "With ether the blood-pressure may remain constant for several hours . . . ."

Concerning the causes of the lowered blood-pressure in the later stages of ether anæsthesia, all writers are not agreed. There are no investigators who throw the blame on the heart alone. The consensus seems to be that the combined effects of the anæsthetic on both heart and vasomotor mechanism constitute the blood-pressure lowering factors. Of the three great factors in the maintenance and stabilizing of the blood-pressure, the rate, strength and volume of the ventricular contractions and the peripheral resistance, as represented by the arteries of the peripheral and splanchnic circulation, are the principal entities.

Lyman<sup>6</sup> says the blood-pressure is lowered because of a relaxation of the vascular canal, opposed to a heart that beats less energetically. The combination of these two pressure lowering conditions brings about the result noted.

Gwathmey<sup>8</sup> says that ether becomes a cardiac depressant in the later stages of anæsthesia, or when a toxic amount of the drug has been

given. This, with a depressing effect on the vasomotor centre, which brings about a general arterial dilatation, causes the fall of blood-pressure.

Cushny,<sup>11</sup> in commenting on the conditions of the phenomenon, states that "the fall of blood-pressure in prolonged ether anæsthetic is due mainly to the weakness of the heart, along with a dilatation of the peripheral vessels."

Some do not agree that the conditions of both heart and arteries are to blame. Hewitt<sup>12</sup> thinks the fall of blood-pressure, met with under certain anæsthetics, is due to direct vascular dilatation, while Sollman<sup>13</sup> says that the condition is due partly to a direct action of ether on the vasomotor mechanism, but is aided by the asphyxia.

Attacking the problem from the standpoint of anatomical changes in the brain cells of dogs subjected to long-continued ether anæsthesia, Butler<sup>14</sup> in this laboratory demonstrated unvaried cell changes of depression as the end result. The nervous control of both the heart and the vasomotor mechanism would thus more probably be involved, though this does not exclude the direct action on the heart and vessels.

The conclusion of the majority of investigators that the hypotaxis under question is conditioned by the combined depressing effects of the anæsthetic on the heart and vasomotor mechanisms is in accord with the conclusions of this laboratory.

*The Condition of the Peripheral Arteries.*—There seems to be no disagreement as to the dilatation of the peripheral arteries during ether anæsthesia. Weber<sup>15</sup> remarks that after general ether anæsthesia there are evidences of perverted vasomotor functioning, lasting for several days. Lyman<sup>6</sup> says the inhalation of considerable quantities of a powerful anæsthetic results in paralysis, and soon produces relaxation of the vascular canal. Muehlberg and Kramer<sup>16</sup> assign vasomotor paralysis as one of the causes of death under ether. Gwathmey<sup>8</sup> states that there is a general arterial dilatation, agreeing with Cushny<sup>11</sup> and Sollman.<sup>13</sup>

This arterial dilatation is so marked that there is a perceptible increase in hemorrhage from severed arterioles during an operation. Luke<sup>17</sup> states that under ether anæsthesia ". . . incised parts are often very vascular, the surgeon not uncommonly remarking on the free hemorrhage."

Oliver<sup>18</sup> graphically demonstrated the actual increase in size of the radial artery during ether anæsthesia. After many experiments with his clever arteriometer he concluded that ether invariably increases the caliber of the arteries.

*The Origin of the Dilatation.*—There is not so much agreement concerning the origin of the dilatation. There seems to be a preponderance of evidence that it is conditioned by the action of the anæsthetic on the vasomotor centre.

Chief of those maintaining that the vasodilatation is not due to the action of the anæsthetic on the vasomotor centre, is Cushny<sup>11</sup>, who says: "Ether seems to have little or no direct action on the vasomotor centre, but the dilatation of the skin vessels indicates that it excites the vasodilator function." Hewitt<sup>12</sup> specifically states that according to certain researches "fall of blood-pressure, met with under certain anæsthetics, is referable rather to direct vascular dilatation than to dilatation of central nervous origin."

On the other hand, Weber<sup>15</sup> notes that the central vasomotor mechanism is extremely sensitive to injurious influences brought by the blood, and that ether exerts these injurious influences to a degree about midway between that of local anæsthesia and chloroform. Meyer and Gottlieb<sup>9</sup> say that "Large doses of narcotics or other central depressants cause gradual diminution of, and final general paralysis of, the vasomotor centres." Potter<sup>7</sup> agrees with this view.

#### THE PROBLEM

The purpose of this investigation was to demonstrate graphically the actual changes in the condition of the peripheral circulation and in blood-pressure accompanying long-continued ether anæsthesia, and the relation which the vasomotor changes may have to the blood-pressure. The results will be analyzed along with other understood phenomena, to see what correlation there may be between the sum of the conclusions and any one of the theories of causation cited above. It is also necessary to answer the question as to what neutralizing or other effect the anæsthetic may have in other experimental operations requiring mechanical technic, the trauma from which usually brings about the symptom-complex recognized as shock. This series of experiments should give a fair working hypothesis, therefore, of the relation between shock and depression.

It is proposed, therefore, to show (1) that there are definite changes in the condition of the blood-vessels of the periphery closely following long-continued ether anæsthesia, the term periphery to mean the whole of the legs, and the body musculature with skin; (2) that there are certain definite conditions of blood-pressure during the experiment; (3) and that these changes of vasomotor control and of blood-pressure are

## BLOOD-PRESSURE DURING ETHER ANÆSTHESIA

in direct relation to each other. Further, it is proposed (4) to outline the direct relationship between shock and depression, and to show (5) what basis there is for accepting any one of the theories cited in the introduction.

### METHODS OF EXPERIMENT

A uniform method of administering ether was necessary, as well as a reliable method of graphically demonstrating the variations of the vasomotor mechanism, and the changes in blood-pressure.

The ether was administered through a tracheal cannula, connected by a rubber tube to a glass ether bottle one liter in capacity. On inspiration the outside air was conducted below the surface of the ether by a glass tube open at both ends and thrust through the cork, and drawn up in bubbles through the ether. By raising or lowering this intake tube, the concentration of ether vapor in the air supplied to the lungs could be very well regulated. Most of the expired air was thrown out through a one-way valve between the trachea and the ether bottle.

In order to avoid the effects of acapnia<sup>10</sup>, the rubber tube of large diameter between the ether bottle and the tracheal cannula was lengthened or shortened as required, thus constituting a type of rebreathing apparatus. The animal used was allowed to die at the end of the experiment, and it was not thought necessary to warm the ether vapor.

It is not necessary to repeat the description of the method of graphic demonstration of the vasomotor and blood-pressure changes. The same form of leg plethysmograph, recording through a water system manometer, was used as described in a former paper<sup>1</sup>. The blood-pressure tracing was taken from the carotid artery connected with an ordinary mercury manometer.

### DESCRIPTION AND EXPLANATION OF EXPERIMENTS

Dogs weighing from 6 kg. to 10 kg. were used. No drugs such as curare and morphine were used, as in the experiments referred to before. After the dogs were anæsthetized, the dissection in the neck was made the first procedure. One of the hind legs was then shaved from the knee down and the plethysmograph was adjusted. This technic usually required about one hour's time, consequently the record of the changes begins after the dog had been under the anæsthetic for this period; therefore, the first effect of the anæsthetic on the vasomotor mechanism and blood-pressure is not recorded.

For the first hour the drum was allowed to move a little at intervals of five minutes each. At the end of the first hour of the record, the

observations were taken every fifteen to thirty minutes. By close attention for a short time the air-intake tube and the rebreathing tube could be adjusted so that the subject would get a steady supply of anæsthetic vapor, heavy enough to maintain the third stage of anæsthesia. The experiments were allowed to run as long as six hours, unless terminated by some untoward incident.

After the death of the animal, the mechanism was calibrated and the records made permanent by fixing in shellac<sup>1</sup>.

Of the many records secured, several were discarded because of mechanical errors, but these all showed the typical graphs.

Six of the graphs have been analyzed in the accompanying table.

#### DISCUSSION OF EXPERIMENTS

The shortest experiment was one hour in length, the longest one, six hours and ten minutes. Three experiments were six hours, or over, in length, and two were over three hours in duration.

*The Blood-pressure.*—In the three shorter experiments the blood-pressure was from 19 to 70 mm. Hg lower at the end of the experiment than at the beginning. In the three longer experiments the blood-pressure was from 12 to 21 mm. Hg higher than at the beginning. In four cases out of six there was a slight fall of blood-pressure at the end of the first half hour. Two of these showing such a fall (Experiments 10 and 12) had a continuous fall to death, while Experiments 3 and 8 showed a slight gradual rise to death. Experiment 9 showed 16 mm. Hg rise at the end of the first half hour, but ended finally in a 19-mm. fall. Experiment 11 showed a 16-mm. rise at the end of the first half hour and ended in a total rise. In all cases there was a relative slowing of the heart, progressing towards the end of the experiment. Time records were not kept. Also there was a marked increase in amplitude of individual beat which seemed to vary with the slowing of the rate.

*The Vasomotor Reactions as Indicated by the Leg Volume.*—In five to forty minutes after the adjustment of the plethysmograph a change in leg volume was noted, three cases showing a vasodilatation, and three showing a vasoconstriction. At the end of the first half hour there was a general vasodilatation shown except in one case. At the end of the first hour (the second hour of anæsthesia) all cases showed a marked vasodilatation, which condition slowly increased, with occasional periods of vasomotor recovery, until at death there was a total increase of leg volume of 2 cu. cm. to 18 cu. cm.

# BLOOD-PRESSURE DURING ETHER ANÆSTHESIA

TABLE I  
DATA OF EXPERIMENTS

Number of experiment	Length of experiment in hours	Time in minutes elapsing before change of leg volume	Character of volume change			Total increase of leg volume at end of experiment in cubic centimetres	Blood-pressure in mm. Hg				Total fall of blood-pressure	Total rise of blood-pressure	Periods of recovery of volume
			Five-minute intervals		Remainder of experiment		At end of		At start of experiment	At end of experiment			
			First half hour	Second half hour			First half hour	Second half hour					
3	6 1/12	40 rise	No change	2 1/2 c.c. increase	Irrregular increase	8.5	104	112	108	122	...	14 mm.	.5 c.c. at end of 2 hours. Rapid recovery. .5 c.c. at end of 2 1/2 hours. Recovery in 10 minutes. .5 c.c. at end of 3 hours. Recovery rapid.
8	6 1/6	5 rise	2.5 increase	3.5 increase	Irrregular increase	14.5	96	96	103	124	...	21	.5 c.c. at end of 40 min. 1.5 c.c. at end of first hour. .5 c.c. during second hour. 3. c.c. during fifth hour. 1. c.c. during sixth hour.
9	3 1/4	10 slight fall	1.5 increase	2.5 increase	Slow, regular increase	7.5	98	108	82	63	19	...	1 c.c. fall below 0 in 10 minutes. 1.5 c.c. at end of first hour.
10	1	5 fall	1 increase	2 increase	Slow, regular increase	2	140	78	148	78	70	...	1.5 c.c. fall below 0 in 5 minutes. Slight recovery at end of first half hour.
11	.6	10 fall	4.5 increase	8 increase	Irrregular increase	18	78	62	62	74	...	12	.5 c.c. fall in 10 minutes. Rapid increase for 25 minutes. 1 c.c. recovery at end of 2 hours. No increase last 1 1/2 hours.
12	4	5 rise	4 increase	7 increase	Slow, regular increase	12	140	120	148	85	63	...	

All cases but one showed a steady progressive increase of the vasodilatation up to the very last half hour of the experiment. Experiment 11, which ran six hours, showed the limit of vasodilatation in four and one-half hours, with no recovery during the last one and one-half hours.

#### GENERAL DISCUSSION AND CONCLUSIONS

Ordinary third-stage ether anæsthesia, prolonged beyond one hour, always results in more or less marked vasodilatation in the periphery. This is a progressive change, more or less regular in character, increasing directly in proportion to the lengthening time of administration. In most cases the limit of vasodilatation is not reached within seven hours after the beginning of the anæsthetic, but occasionally the extreme of the condition may be reached after a shorter administration of the drug.

If the endeavor be made to explain the response of the vasomotor mechanism as being conditioned by the local action of the ether on the peripheral vasomotor mechanism, it is necessary to assume that the results are to be explained by the variation of the normal degree of vasoconstriction-dilatation present in the periphery at the inception of the experiment. It is well known that there is a more or less constant tonic activity of the peripheral vasomotor function in the normal animal. It is conceivable that there may be times when the peripheral arterioles are dilated or contracted to such an extent that any further dilatation or constriction would be impossible; but normally there is a tonic balance of function, the variation being noticeable only within the narrow limits set by the requirements of the mechanics of circulation.

Granting that the degree of dilatation or constriction of the peripheral arteries at the beginning of the experiment varies with different individuals, it can be safely said that the variation is not great enough to be considered as limiting or conditioning the present graphic result.

If an explanation is based on the hypothesis that the vasomotor centre is the variable factor in bringing about the vasomotor change, one may say that the variation of response is directly dependent upon the anatomical-functional changes in the nerve cells of the vasomotor centre produced by ether. This centre cannot escape such changes as are demonstrated by Butler<sup>14</sup> as the general effect of ether, as hereafter explained.

In half the cases cited there is a decided fall in blood-pressure. It is noted also that the time length of the experiment was in these instances much shorter than others showing different net end results. The

three tabulated experiments, running six hours or more, showed the blood-pressure to be slightly more than maintained. There is then a disturbance of the normal physiologico-mechanical relation between two of the three great blood-pressure controlling factors, *i. e.*, the rate and strength of the heart, and the peripheral resistance in the arteries. This disturbed relation is shown by the behavior of the blood-pressure in three of the cases. There is a fall of blood-pressure as an end result in these three cases. This, of course, is what would be expected in the presence of such great vasodilatation.

The normal tone and resistance in the arteries have been altogether or partly destroyed in all cases, and the blood-pressure lowering effect of this one factor, obtaining throughout all of the periphery, must be tremendous. Why, then, is there in half the cases a decided and fatal fall in blood-pressure, and in the other half a decided maintenance of the tension? It is evident that the question must be answered by considering the normal compensatory reaction to the blood-pressure lowering tendency of the peripheral dilatation on the heart. While the heart did not increase in rate in any instance, there was a decided increase of ventricular output, an increase great enough to overcome the hypostatic effect of the peripheral dilatation: the blood-pressure was maintained and even raised a little. It is evident that if the heart fails to show this compensatory reaction, because of organic disease, or too early response of the nervous centre to the effect of the anæsthetic, the blood-pressure must fall, as it did in the three cases noted.

In considering the three cases showing the failure of cardiac compensation, it is permissible to argue that any means of preventing or overcoming the peripheral vasodilatation would have resulted in maintenance of blood-pressure.

In a former paper<sup>1</sup> it was clearly shown that trauma to the exposed intestines brings about a certain vasomotor response in the blood-vessels of the periphery, and this response is a reflex vasoconstriction. Interesting to note also is the fact that in seven experiments, from 45 to 165 minutes in length, the blood-pressure was either nearly exactly maintained, as in two cases, or was higher at the end of the experiment than at the beginning, as in three cases. Only two cases showed a fall of pressure at the end, and these results were obtained from dogs living less than an hour after the beginning of the trauma, the leg volume tracing in both cases showing little or no vasoconstriction to offset the heart failure.

In the light of what we have learned from all experiments it is safe to say that in the ordinary major operation, with ether as the



anæsthetic, a moderate amount of excitation from handling is a helpful factor. There can be no question that there are occasions at times, with the patient on the verge of syncope from ether-depression, when a vigorous cutaneous or visceral irritation would restore the vasomotor tonus, resulting in a beneficial reflex rise in pressure. Bearing on this generalization, we repeat the notes of Experiment January 31 in a former paper referred to above<sup>1</sup>: "In one experiment (January 31) the handling of the intestine immediately brought about a slight fall in the volume of the leg with at first a fall then a rise in blood-pressure. When the handling ceased for two minutes the leg volume went up, the blood-pressure remaining about normal. When the manipulation was taken up again there was a fall in volume. These transitory changes in leg volume and blood-pressure went on through the whole experiment (52 min.), the general trend of the volume being downward, so that at the end of the experiment there was a permanent fall of 5 cu. cm." This case, on the experimental side, shows the sensitiveness of the vasomotor mechanism to reflex stimulation, and it is clear how such a reflex stimulation, in proper time and moderation, may very well become a remedial measure in impending ether death. Weber<sup>15</sup> recognizes this principle when he treats by alternate hot and cold douches the disturbances of the vasomotor mechanism after general anæsthetics.

It is interesting, indeed, to read of Kirstein's four cases<sup>20</sup>, the report of one of which has been abstracted<sup>21</sup>. One case of cessation of the manipulation of the peritoneum during a laparotomy arrested the respiration and heart beat. He theorizes that the amount of anæsthetic required depends on the intensity of the irritation from the operative procedures, a certain amount of anæsthetic balancing a certain amount of irritation. If this irritation stops suddenly, the anæsthetic then makes its influence felt more on the general system, so that anæsthesia slides into the danger phase. The narcosis-asphyxia came on suddenly when the operator had finished with his investigation and manipulation of the peritoneum.

In the case just cited it is evident that the sensory stimulation from the manipulation of the peritoneum was the prop which supported the function of the centres of respiration and circulation. The stability of function of the vital centres in the medulla under such conditions is, therefore, more apparent than real.

Reasoning from the same facts toward the same end, namely, the safety of the patient, Oliver<sup>18</sup> says, "Inasmuch as I have shown that operative procedures are apt to throw an increased strain on the heart

## BLOOD-PRESSURE DURING ETHER ANÆSTHESIA

and great vessels by causing extensive contraction of the middle and smaller sized arteries, it would seem to follow that those anæsthetics will be the safest that maintain the heart's action and the fullness of the arteries."

As being of interest on this topic, one of Henderson's conclusions is here given: "Morphine and complete anæsthesia counteract the development of shock by quieting the respiration"<sup>22</sup>.

So we come naturally to the fundamental question of excitation versus depression. Verworn early defined these as "quantitative opposites, activity being an increase, depression a decrease in the intensity of vital phenomena." Anatomically, so far as concerns the analysis of the function of the nerve cell, this is supported by actual volumetric comparison (Dolley<sup>23</sup>).

These processes depend upon the fundamental property of irritability of protoplasm. To show the scope of this property, there are only two other fundamental ones concerned in dynamic reactions, reproduction (division of cells) and nutrition. Function of the nerve cell is deduced as the manifestation of its irritability which has been determined by specialization, anatomic differentiation (Dolley<sup>25</sup>). The stimulus to the irritability, as Verworn defines it, is "Every alteration in the external vital conditions." Stimuli, therefore, are either excitant or depressant. In respect to irritability, nervous phenomena can be only referable primarily to excitation or depression, or both.

Excitant stimuli produce function in the usual sense. Looking now only at end results, if excitant stimuli are excessive, there results a using up of substance faster than it can be replaced, which in the earlier stages is an organic fatigue, and which leads to eventual organic exhaustion. Depressant stimuli produce depression, the lowering or blocking of function, its diametric opposite. In moderate degrees depression corresponds to fatigue of another sort, such for example as occurs in the accumulation of waste products, or the blocking of function may be complete.

There are then two kinds of fatigue, from excitation and depression. Both may lead to an absolute condition, either complete exhaustion or depression. But, though the end result is reached by entirely different processes, its effect is identical in a complete functional incapacity. An exhausted cell is just as incapable of function as is a depressed cell.

To understand the effect of ether, therefore, one must keep in mind its relation as a stimulus. It belongs to that more common group which are only different in that they combine excitation and depres-

sion, first exciting, then depressing. The depression is its essential effect.

To understand the primary effect of an operation, it must be kept in mind that the primary stimuli are excitant only, being mechanical. Their effect then is wholly excitatory, leading to overactivity, and, if long enough continued, to more or less of fatigue, and possibly to exhaustion. So the primary effect of shock is overfunction, though it is to be noted that this effect is only displayed outwardly according to the body mechanism which permits its display. Anatomically it is a general phenomenon for the nervous system.

It is evident that when sensory stimuli and the anæsthetic are exhibited together as in any ordinary surgical operation there is one period when the excitation from the surgical technic and the depression from the drug are pitted against each other, to the good of the patient. There is a later period when the two antagonists become allies in effect, and total functional incapacity and death come about quicker than when only one agent has been at work.

It has been concluded, therefore, that the symptom-complex known as post-operative shock is a combination of the effects of excitation and depression and varies directly with the algebraic sum of these two factors (Dolley<sup>25</sup>).

Proof that the phenomenon of vasodilatation rests entirely on the extent of dilation or constriction in the arteries at the inception of the experiment rather than on the central reaction, demands a graphic demonstration of the absolute vasomotor changes taking place during the first hour of anæsthesia. To proceed to base conclusions on the changes noted *after* the first hour of anæsthesia is unsound practice. There is every reason to believe that when the inhalation of ether is begun there is a condition of increased tonicity of the vasomotor system. The extreme excitement accompanied by the heightened blood-pressure are sufficient grounds for assuming that there is a heightened activity of the vasoconstrictor function. It is probable, therefore, that in the ordinary ether anæsthesia, conducted into the third stage, the vasomotor response runs through phases of excitation into depression. Granting, however, that some part of the result is peripheral in origin, against which there is no objection, the essential effect must be central, simply from the difference in degree of irritability in one against the other, the smooth muscle cell against the nerve cell.

"Ether anæsthesia produces certain definite anatomical changes in nerve cells of dogs. The changes are first those of mild activity and later there are superimposed changes of depression depending in se-

verity upon the duration of the anæsthesia. The changes first make their appearance microscopically in one and one-half to two hours. Anæsthesia of two to six hours produces a moderate depression, one up to eight hours a marked depression, and one of more than eight hours a profound depression, with the beginning of necrobiosis.

"The severity of the anatomical changes in the nerve cell appears to be in direct relation to the length of the anæsthesia, allowances being made for individual variations.

"The changes vary in degree in animals of the same species kept under the same form of anæsthesia for the same length of time." (Butler.<sup>14</sup>)

It is true that no one has ever studied the anatomical changes in the cells of the vasomotor centre in the medulla after prolonged overstimulation, or after ether anæsthesia. Indeed, it is impossible even to locate these individual functionally specialized cells with any degree of accuracy.

We may base our argument on Dolley's<sup>24</sup> conclusion: All nerve cells go through the same quantitative sequence of changes in their function, exhibiting therein a unity of mechanism. Because of this unity of mechanism deductions from any single type of cell which relate to the fundamental quantitative principle may be applied to all.

#### SUMMARY

1.—Ordinary third-stage ether anæsthesia prolonged beyond one hour results in more or less marked vasodilation in the periphery. This is a progressive change, more or less regular in character, increasing directly in proportion to the lengthening time of administration. In most cases the limit of vasodilatation is not reached seven hours after the beginning of the anæsthetic, but occasionally the extreme of the condition may be reached after a shorter administration of ether.

2.—There is a direct relationship between the condition of the vasomotor control and the blood-pressure.

3.—The end result of ether depression is loss of function. The symptom-complex, known as post-operative shock, is a combination of the effects of excitation and depression, and varies directly with the algebraic sum of these two factors.

4.—The vasomotor centre is the variable factor in bringing about the vasomotor change; the variation of response is directly dependent upon the changes in the vasomotor centre produced by ether.

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## BLOOD-PRESSURE AND PROSTATECTOMY

BY ALEXANDER HAMILTON PEACOCK, M.D.  
OF SEATTLE, WASH.

THERE is a vital and definite relationship between the vascular system and the renal functioning, which is measured by the blood-pressure. And as old age and obstruction of the lower urinary tract greatly raise this pressure, we view with interest anything which suddenly decreases it, as serious complications often result.

*Effects of Chronic Prostatic Obstruction on the Blood-pressure.*—Outside of the dilation and hypertrophy of the bladder and ureters, resulting from chronic prostatic obstruction, we have increased difficulty of renal excretion which requires a greater blood-pressure to filter the blood through the kidneys. This naturally calls for a greater blood-pressure, so we are not surprised to find a high pressure (above 150 mm. Hg) in most cases of prostatism. It is not uncommon to also find a polyuria, a low specific gravity and the absence of albumen. The greater the obstruction and the longer it has endured, the higher the blood-pressure is the rule.

*Effect on the Blood-pressure of Suddenly Removing the Urinary Obstruction.*—Whether this is accomplished by a urethral catheter, cystotomy or suprapubic puncture, the results are all the same. Within a few minutes the blood-pressure falls from ten to even one hundred millimetres of mercury. As a result of this suddenly lowered pressure, the force through the renal filters is also decreased, decidedly less urine is excreted, the specific gravity rises, and infrequently casts and albumen appear, with all the symptoms of an acute nephritis. This change which takes place in from 25 to 50 per cent. of operative prostatics, a change from active, albumen-free kidneys to a condition of anuria, casts and albumen, I have called hidden nephritis. It is the real cause of the high mortality of prostatectomy; not shock or hemorrhage.

It is most essential, therefore, to watch closely the blood-pressure readings, and for the appearance of albumen and casts after relieving urinary back pressure. At the first signs of a hidden nephritis, active anti-uræmic treatment must be instituted at once.

I can do no better than report in detail a few of my own prostatectomies and suggest to those who wish confirmation of this interesting and serious change, to make a few observations of their own, on their next prostatic subjects.

CASE I.—*History*: Age 64, retired from business. Health fair. Cardiovascular System—Mitral and aortic lesions, good compensation. Blood-pressure, 140 mm. Hg.

*Urinary System*.—Residual urine, 12 ounces, clear, low specific gravity, no albumen, no casts. He has been troubled a long time with prostatic obstruction. Rectal palpation reveals a large gland, smooth, fairly soft, no nodules, left lobe prominent.

*Operations*.—November 11, 1915, Drs. Horsfall and Gardner performed a suprapubic cystotomy, employing 2 per cent. novocaine. The bladder was distended and had thick walls; a large fibroma of the central lobe blocked the vesicle urethra. The blood-pressure fell from 140 mm. Hg to 105 mm. Hg, immediately after opening the bladder. November 16, 1915, five days later; an enucleation was accomplished under spinal anæsthesia. A good recovery resulted.

CASE II.—*History*: Age 64, farmer. Height 5 feet 11 inches, weight 160 pounds. Has had a large right inguinal hernia for years; no serious illness or accident.

*Cardiovascular System*.—The pulse is full, strong, 68, regular. Arteries moderately sclerosed. Blood-pressure 260 mm. Hg.

*Urinary System*.—He has difficulty in voiding for past five years; lately urine dribbles constantly, no stream at all. Pain over the distended bladder. The urine is pale, specific gravity 1.010, very clear, free of sugar and albumen; cylindroids are present. Rectal exploration, discovered a large soft prostate, about three inches long; external, a few mucocutaneous hemorrhoids.

*Operation*.—January 24, 1916, suprapubic cystotomy, using urea and quinine anæsthesia, preceded one hour with morphine,  $\frac{1}{4}$  grain; the patient was quite drowsy. After ligating several large vessels in the bladder wall and inserting a purse-string suture, the bladder was opened. The blood-pressure fell immediately from 260 to 150 mm. Hg. From then on the quantity of urine excreted was gradually diminished, the specific gravity rose from 0.010 to 1.028, and albumen made its appearance. The patient soon refused to eat, and two days later started to vomit, refusing even water. The wound was clean, with no bleeding, the temperature became subnormal, the blood-pressure continued to fall; death from uræmia occurred at 1:30 P.M., January 28, 1916, four days after relieving the intravesicle pressure, by a simple drainage.

CASE III.—*History*: Age 70, retired from business. He stated that he had always been well. Recently there has been loss in weight, slight fever, increase in pulse rate and sweats occur at night. He is 5 feet 4 inches tall and weighs 135 pounds.

## BLOOD-PRESSURE AND PROSTATECTOMY

*Cardiovascular System.*—Pulse 84, regular, vessels sclerosed. Blood-pressure, (a) systolic, 140 mm. Hg, (b) diastolic, 100 mm. at 3 P.M.

*Urinary System.*—Six years ago he first experienced difficulty in voiding. His urine has contained pus and blood for some time. Residual urine of 300 c.c. blood tinged. Sound No. 24 F. into bladder, capacity of latter 700 c.c. By rectal palpation, a mild enlargement of both lateral lobes of prostate made out. It was mechanically impossible to insert a cystoscope. Urinalysis, specific gravity 1.010, albumen faint trace (due to blood present), no sugar, many pus cells, red blood-cells, plate epithelium, a few staphylococci and many bacilli.

*Operations.*—November 10, 1915, under ether anaesthesia, a suprapubic prostatectomy was performed. After inserting a purse-string suture, the bladder was opened; the middle lobe nourished a fibroma, three inches in length and resembling a pear. The prostatic pouch was foul, with pus and mucus. The blood-pressure fell from 140 mm. Hg to 120 mm. Hg. Two weeks after the operation he had two intravesical hemorrhages from the prostatic capsule; this was packed. Good functional recovery.

*CASE IV.—History.*—Age 84, widower, born in Canada of Irish and English parents; by trade a shoemaker. Always enjoyed excellent health. Height 6 feet; weight 170 pounds.

*Cardiovascular System.*—Pulse full, strong, vessels sclerosed. Blood-pressure 220 mm. Hg.

*Urinary System.*—For some time past has had difficulty in voiding, and past three days, has had complete retention, catheterization being necessary. Strictures in membranous urethra. 900 c.c. of dark concentrated urine obtained with catheter; specific gravity, 1.025, no albumen, no casts. Rectal palpation made out a slightly enlarged prostate of soft consistency.

*Operations.*—December 20, 1915, suprapubic cystotomy, novocaine solution. After relieving the bladder of its tension, the blood-pressure dropped from 220 to 190 mm. Hg. December 24, 1915, prostatectomy was performed, using Babcock's intraspinal solution. After waiting twenty-five minutes, the anaesthesia was so slight, chloroform was employed. The lateral lobes were of moderate size and a small fibroma of the median lobe was removed. No shock. He made a perfect functional recovery.

*CASE V.—History.*—Age 64, contractor, born in New York State, Dutch descent. Mother died of carcinoma of bowels and father of cholera. The patient has lived an active out-door life, chiefly manual labor. He remembers having had the following illnesses: mumps, measles, scarlet fever, diphtheria, fever and



ague, a bite by a copperhead snake and two attacks of gonococcus infection. Height 5 feet 9 inches, weight 136 pounds.

*Cardiovascular System.*—Pulse full, 64, regular; vessels, moderate sclerosis. Heart, no murmurs; sounds not clear as there is no snap to the valves. Blood-pressure is 140 mm. Hg.

*Urinary System.*—He has had difficulty in voiding for the past few years, having "to pump" to start the urine; small stream, frequency at night. The voided urine is clear, specific gravity 1.020, albumen, sugar and casts absent. Residual urine, 100 c.c. clear. Sound No. 24 F. was obstructed in the prostate.

*Operations.*—February 26, 1916, using quinine infiltration, a suprapubic cystotomy was performed. The blood at the start was 137 mm. Hg. after opening the bladder, 155 mm. Hg. Two days later, at noon, the pressure was 117 mm. Hg. and the pulse slightly intermittent, dropping every sixth beat. Urine greatly decreased, specific gravity, 1.029, albumen, 9 grams or 75 per cent. by bulk, many casts, both hyaline and granular. February 29, 1916, supraprostatectomy, very light chloroform anæsthesia, lateral lobes and isthmus enucleated in one mass. Capsule packed. Nephritis was combated with potassium acetate, digitalis and pulverized kidney gland. One month later, patient came to my office, entirely healed. Urine clear, faintest trace of albumen, no casts and a few cylindroids. Blood-pressure, 3.30 P.M., systolic 110 mm. Hg, diastolic 80 mm. Hg.

*CASE VI.—History.*—Age 73, retired from business, born in Maine. Lived a temperate life. General health good; failing a little in last two years.

*Cardiovascular System.*—Heart rate, 72, every 15th beat intermits. Blood-pressure, 10.30 A.M., in bed, (a) systolic, 148 mm. Hg; (b) diastolic, 90 mm. Hg.

*Urinary System.*—Troubled for past five years with obstructed urination; stream slow, hesitating, twisted, no force. A number of times bleeding from meatus. Past few days, unable to void, catheter employed. Pain in bladder intense and urine quite bloody. Rectal palpation, discovers a large, soft prostate. Urine, 36 ounces in twenty-four hours, blood-tinged, specific gravity, 1.024, albumen, faint trace (blood), sugar absent, no casts.

*Operations.*—March 28, 1916, suprapubic cystotomy, 1 per cent. novocaine. Pressure before opening bladder, systolic, 150 mm. Hg; after, 140 mm. Hg. Three days later, 9:30 A.M., urine, 1.030, albumen, heavy ring; hyaline and granular casts. Pressure (a), systolic 128 mm. Hg, (b), diastolic 70 mm. Hg. April 1, 1916, prostatectomy while under nitrous oxide anæsthesia.

## BLOOD-PRESSURE AND PROSTATECTOMY

Two large lobes enucleated, weight  $4\frac{1}{2}$  ounces. There was slight oozing in spite of packing in prostatic bed; stopped immediately with 10 c.c. horse serum. The drugs to combat the nephritis were stopped on account of gastric irritability. Everything went smoothly until the fourth day, hiccough started, the pulse increased in rate, the urine stopped secreting, the blood-pressure fell steadily, coma set in and lasted for twelve hours. Death from uræmia.

*CASE VII.—History.*—Age 58, laborer, Scotch descent, born in Canada. He has lived a hard life, chiefly manual labor; wandered extensively. Has never been robust. Height 5 feet 11 inches; weight 155 pounds. No serious illness.

*Cardiovascular System.*—Pulse 74, regular rhythm, volume large; vessels moderately sclerosed. The systolic blood-pressure is 250 mm. Hg.

*Urinary System.*—There has been difficult voiding for several years and at times the stream is almost shut off; there is frequent micturition at night. The urine is clear, 1.022, and free of albumen, sugar and casts. A finger in the rectum feels a slightly large prostate. Residual urine, 45 c.c.

*Operations.*—April 22, 1916, a suprapubic cystotomy under urea and quinine anæsthesia. Pressure before opening the bladder, 243 mm. Hg; immediately afterward, 220 mm. Hg. Two days later, patient had a coated tongue, a uriniferous breath, pulse 104, blood-pressure (a) systolic, 170 mm. Hg (b) diastolic, 120 mm. Hg. Anti-uræmic treatment instituted. April 25, 1916, urine, albumen heavy ring, hyaline casts, diminished amount. Prostatectomy under nitrous and oxygen anæsthesia. From then on, it was a fight with uræmia, excellent nursing winning out. The last urinalysis, June 8, 1916, specific gravity 1.020, clear, no albumen, no casts. Blood-pressure 180 mm. Hg.

Some time ago, D. C. Balfour of the Mayo Clinic, in a paper on "The Care of Surgical Patients," spoke of the great value of preparatory treatment in prostatic cases. The preliminary drainage of the bladder clears up the urine and lowers the blood-pressure, he asserts. Crenshaw states that in the last fifty cases of prostatectomy in the Mayo Clinic, preliminary drainage has been used, with an average drop in blood-pressure from 166 to 145 mm. Hg.

Recently, D. F. Cameron, of the Brady Urological Institute of the Johns Hopkins Hospital, reported some new studies of renal secretion, entitled "Variations in Renal Function Dependent on Surgical Procedures," which is exceedingly interesting. Little by little, the haze is lifting, and we understand better, the estimating of renal secretion, normal and abnormal. Cameron mentions the functional changes

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following the relief from back pressure of the urine; this is accomplished by a drainage of the bladder, by an in-lying catheter; my own experience has shown that there is just as great a fall of blood-pressure on catheterizing an obstructed bladder as there occurs with a cystotomy. This is probably the reason we have always been warned never to completely empty a distended bladder and why shock and even death has followed this simple operation of catheterization.

# TABULAR ANALYSIS OF THE SEVEN CASES.

	Operation	Primary Blood- Pressure.	Immediate Blood-Pressure- Fall.	Events
I.	Preliminary cystotomy.....	140	35 mm. Hg.	Uneventful recovery.
II.	Preliminary cystotomy.....	260	110 mm. Hg.	Nephritis developed, death 4th day, uræmia.
III.	Prostatectomy .....	140	20 mm. Hg.	Good recovery.
IV.	Preliminary cystotomy.....	220	30 mm. Hg.	Uneventful recovery.
V.	Preliminary cystotomy.....	137	22 mm. Hg.	Nephritis developed, recovery.
VI.	Preliminary cystotomy.....	150	10 mm. Hg.	Nephritis developed, death 4th day.
VII.	Preliminary cystotomy.....	250	30 mm. Hg.	Nephritis developed, recovery.

## NOTES AND CONCLUSIONS

1.—There is a definite physiologic relation existing between the blood-pressure and the filtration in the kidney glands.

2.—That a high blood-pressure is purely compensatory, and necessary to the individual in which it is found, to maintain a normal excretion of urine.

3.—That any sudden and permanent lowering of the blood-pressure by radical or heroic measures is often a fatal procedure.

4.—That a persistently high blood-pressure, even in the absence of albumen and casts, usually means a hidden nephritis.

5.—That a chronic prostatic obstruction produces serious back pressure changes in the ureters, the kidney substance, the kidney circulation and the excretion of urine.

6.—That a sudden relief of this intravesical pressure produces an immediate fall in blood-pressure, from 20 to 100 mm. Hg.

7.—That if the pre-operative blood-pressure is much over 150 mm. Hg, the risk of a cystotomy or prostatectomy advances rapidly.

8.—That compensation between the blood-pressure and the urinary excretion will take place if the pressure is not abnormal and will occasionally in a high pressure where there is unusual vitality or compensatory power.

# FURTHER OBSERVATIONS ON THE ANATOMY OF THE SINUS FRONTALIS IN MAN

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It is a well established fact that the anatomy of the adult frontal sinus varies greatly—there is no constancy in size, shape or type. The right and the left sinuses are usually asymmetrical and either or both may be present in duplicate or triplicate (the writer has observed even as many as four frontal sinuses on one side, each with an independent communication with the cavum nasi). There is also considerable variation in the manner of communication of the frontal sinus with the cavum nasi; this is, of course, in accordance with the embryology of the sinus. Agenesis of the sinus has also been reported.

It is not the purpose of this communication to enter into a detailed discussion of the above points. The reader is referred to earlier papers by the writer.<sup>1</sup> Here reference will be made to extremes in development of the sinus frontalis recently encountered. Clinically these variations must be of considerable importance and an appreciation of them will doubtless aid the clinician in clearing up some obscure cases.

Brühl in a study of the sinus frontalis found the capacity of the combined sinuses (right and left) to vary from 6 to 16 c.c. The writer recently encountered two cadavers in which the frontal sinuses were of enormous size, far exceeding Brühl's maximum. So far as I have reviewed the literature, these two cadavers are unique as regards the capacity of the frontal sinuses.

The first specimen is that of an adult male (Fig. 1). The skull presents three frontal sinuses, one on the right side and two on the left. The three sinuses communicate with the frontal recesses of the middle nasal meatus. The whole of the orbital (horizontal) portion of the frontal bone is pneumatized. Indeed, the frontal sinuses are not confined to the frontal bone: Laterally and dorsally they extend into the great or temporal wings (*alæ magnæ*) and dorsally and medially into the small or orbital wings (*alæ parvæ*) of the sphenoid bone. The medial one of the two left sinuses extends into the

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<sup>1</sup> J. Parsons Schaeffer: Univ. of Penna. Med. Bulletin, October, 1909; Amer. Jour. of Anat., vol. x, April, 1910; ANNALS OF SURGERY, September, 1912; Anat. Record, vol. x, January, 1916; Jour. of Morph., vol. xxi, 1911; Amer. Jour. of Anat., vol. xx, July, 1916.

crista galli of the ethmoid bone. The sinuses extend also into the nasal or ascending processes of the maxillæ and into the nasal bones. Numerous finger-like projections of the sinuses have hollowed out the frontal (vertical) portion of the frontal bone (Fig. 1) to an unusual degree.

The total capacity of the three frontal sinuses represented in Fig. 1 is 38 c.c. Everywhere the walls of the sinuses are extremely thin. The enormous capacity of the sinuses in this specimen can better be appreciated when one recalls Brühl's findings. Clinically, it is of importance to appreciate the additional



FIG. 1.—Skull from an adult male. The frontal sinuses as present in the vertical portion of the frontal bone and in the great wings of the sphenoid and in the temporal bones are represented by cross-hatching. Note that there are two sinuses on the left side and one on the right. The orbital extension of the sinuses is, of course, not shown. The combined capacity of these unusually large frontal sinuses was thirty-eight cubic centimetres.

anatomic relationships of the frontal sinuses in such extensive pneumatizations.

The second specimen to which I wish to direct attention is also from an adult male. Here the pneumatization of the frontal and adjacent bones is even more extensive than in the first specimen. Every part of the orbital (horizontal) portion of the frontal bone is hollowed out. The intracranial wall of the frontal sinuses is crowded bullous-like towards the anterior cranial fossa. Extensive and numerous finger-like recesses of the sinuses project variously into the vertical portion of the frontal bone (Fig 2). On both sides the sinuses extend into the great or temporal wings (*alæ magnæ*) and into the lesser wings (*alæ parvæ*) of the sphenoid bone. There is even an extension bilaterally into the tem-

## THE SINUS FRONTALIS IN MAN

poral bones and well down to the root of the nose into the nasal bones and into the nasal processes of the maxillæ.

The enormous size of the frontal sinuses in this skull is well illustrated in Figs. 2 and 3, showing both frontal and intracranial views. The extensive finger-like projections of the sinuses are well shown in Fig. 2. In Fig. 3 the intracranial wall of the sinus is removed, thus exposing the sinuses in their entirety. It is especially important to note the extensive anatomic relationships of the frontal sinuses in this specimen. The two sinuses are markedly asymmetrical. Many recesses and incomplete bony septa are present. The capacity

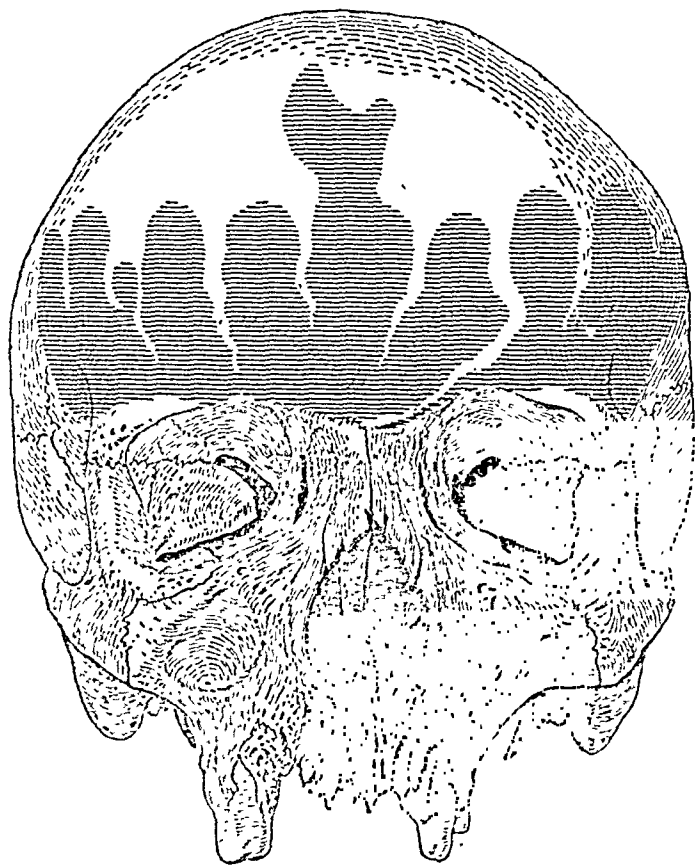


FIG. 2.—From an adult. Two asymmetrical frontal sinuses are present in this skull. The extensive pneumatization of the vertical portion of the frontal bone is represented by cross-hatching. Note the extension into the great wings of the sphenoid, into the temporals, into the nasals and into the nasal processes of the maxillæ.

of the two sinuses (Figs. 2 and 3) is 45 c.c.. In a study of the heads of hundreds of cadavers I encountered many very large frontal sinuses, but such extensive pneumatization of the frontal bone as is found in these two cadavers is unique in my experience.

Agensis of the frontal sinuses is very unusual according to my studies. Such cases have, however, been reported. Errors have doubtless been made in assuming the sinus absent in those cases in which there was no pneumatization of the frontal or vertical portion of the frontal bone. It is well to recall that the frontal sinus is genetically an



outgrowth from the middle nasal meatus <sup>2</sup> and that the first evidence of the sinus must not be sought in the vertical portion of the frontal bone. Indeed, in some cases the frontal sinus never does invade the vertical portion of the frontal bone, development taking place wholly in the horizontal or orbital portion.

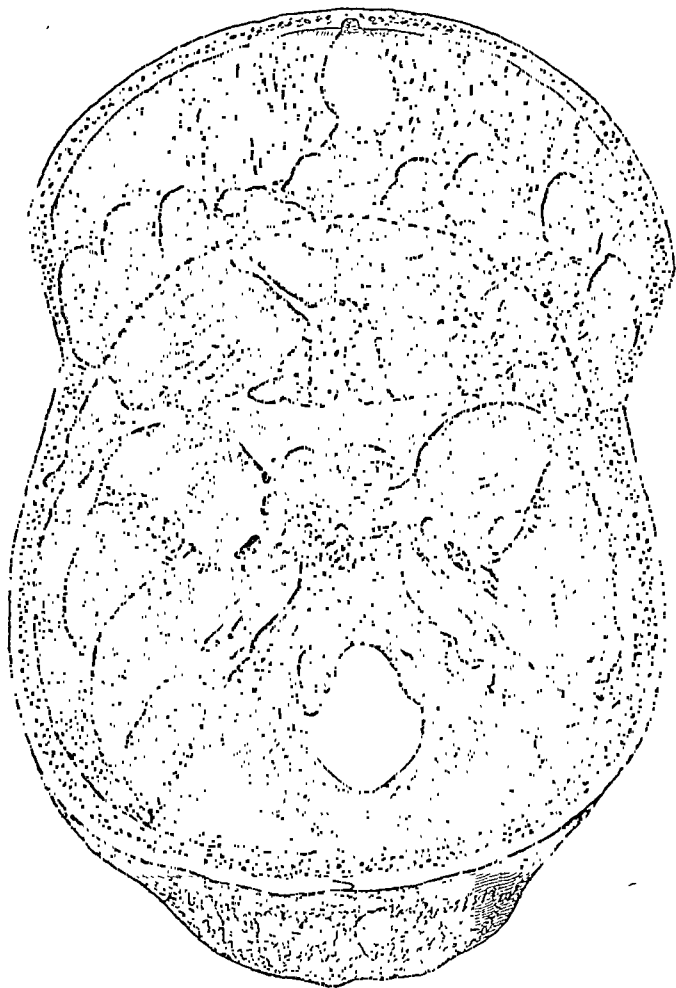


FIG. 3.—Same skull as shown in Fig. 2, illustrating the frontal sinuses by removal of the intracranial wall of the sinuses. Especially note the enormous pneumatization of the frontal and adjacent bones, the many bony septa and recesses and the marked asymmetry of the right and left sinuses. The capacity of the two sinuses in this case (Figs. 2 and 3) was forty-five cubic centimetres. So far as I have reviewed the literature, these are the most extensive frontal sinuses on record.

Witness for example the skull represented in Fig. 5. This specimen was exhibited as a skull with absent frontal sinuses. The vertical saw-cut exposed both frontal lobes of the brain and met at right angles a deep cut made at the level of the nasion (point of contact of the frontal bone with both nasals). Even with this large wedge of bone removed, no frontal sinus was exposed, and in a sense the exhibitor of the skull was justified in declaring the frontal sinuses

<sup>2</sup> J. Parsons Schaeffer: The Genesis, Development, and Adult Anatomy of the Nasofrontal Region in Man. *Amer. Jour. of Anat.*, vol. xx, July, 1916.

absent. Through the kindness of Doctor Hoffman, the writer was given an opportunity to examine the above skull. The orbital type of frontal sinus was at once suspected. Small trephine openings made at the highest point of the nasal processes of the maxillæ revealed two fairly large frontal sinuses hugging closely the ethmoid labyrinth and extending for some distance into the horizontal portion of the frontal bone over the medial and cephalic wall of the orbit. On the left side a supernumerary sinus was found immediately dorsal to the one ventrally placed. On the right side a supernumerary frontal sinus was found

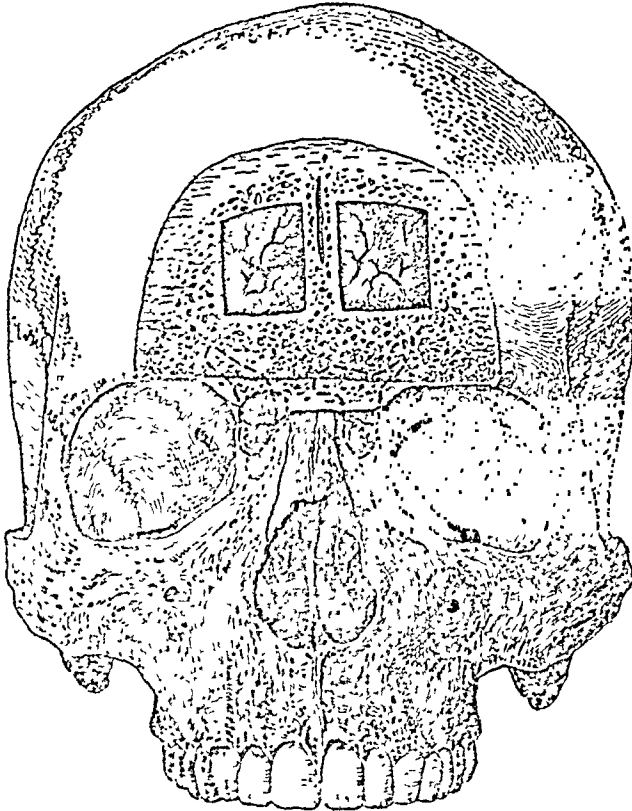


FIG. 5.—From an adult. This specimen was exhibited as a skull with agenesis of the frontal sinuses. Note the large wedge of bone cut out without opening into the frontal sinuses. Openings made at the junction of the frontal bone with the nasal bone and the nasal process of the maxilla revealed the orbital type of sinus hugging closely the ethmoid labyrinth and projecting dorsad and laterad over the orbit and well down to the root of the nose. Two frontal sinuses are present on each side, each with an independent ostium in communication with the frontal recess of the middle nasal meatus. The topography of the two ventral sinuses are indicated by broken lines; the two dorsal sinuses by transverse and vertical hatching. All four sinuses are dorsal to the saw cuts and are wholly orbital in type.

medial to the one first exposed and lateral in position. In the drawing the outlines of the four frontal sinuses are given. They are wholly dorsal to the vertical saw-cut. The ordinary procedure for exposing the frontal sinuses would, of course, have failed to reveal these air chambers in this case.

A common type of duplicate frontal sinus is illustrated on the left side of the adult skull shown in Fig. 4. In this skull the single right sinus has pneumatized both the horizontal and vertical portions of the frontal bone. On the left side the frontal sinus is present in duplicate. The left ventral sinus has invaded both the horizontal and

vertical portions of the frontal bone. Immediately dorsal to the latter sinus is another absolutely independent frontal sinus which has pneumatized the remainder of the horizontal part of the frontal bone as well as portions of the greater and lesser wings of the sphenoid bone. This type of sinus is often overlooked in operative procedures, owing to its depth from the frontal region, its position, and its relations. In order to expose it from the frontal region, the removal of two plates of bone would be necessary.

At times the frontal sinus remains extremely diminutive in size. It is very common to err in these cases and declare agenesis of the

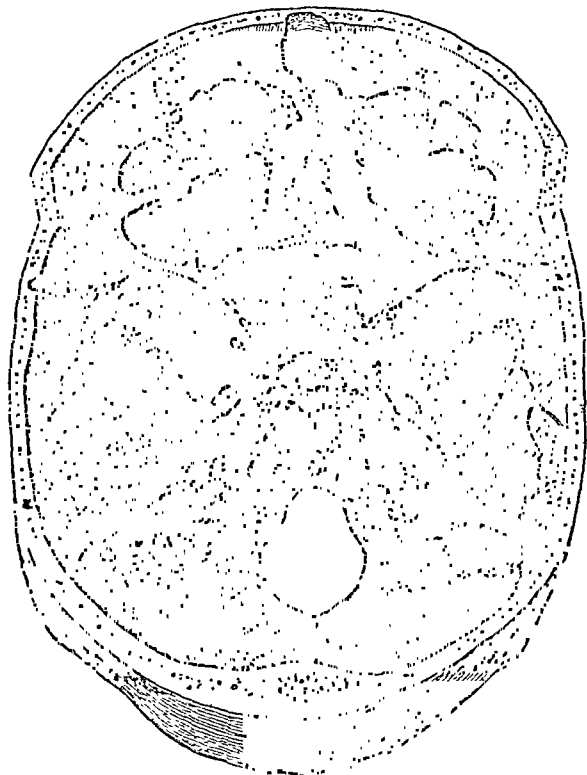


FIG. 4.—From an adult. Skull has three frontal sinuses, one on the right and two on the left side. Especially note the position of the dorsal and orbital sinus of the left side. The latter sinus bears no relation whatever to the vertical or frontal portion of the frontal bone. Two plates of bone separate this sinus from the surface. See text.

frontal sinuses. Only careful search and a realization of the great variations in the anatomy keeps one from "going wrong." Witness for example the dissection illustrated in Fig. 6. Here the frontal sinuses are represented by two small cells located well down toward the root of the nose at the junction of the horizontal and vertical portions of the frontal bone. Their joint capacity is not more than 1 c.c. and they stand in strong contrast to the sinuses represented in Figs. 1, 2 and 3.

In most cases in the first years of childhood and in many instances in the adult the frontal sinus, owing to its location, cannot

## THE SINUS FRONTALIS IN MAN

be reached from the forehead. As pointed out before, in most children and in many adults, there is no frontal sinus in the vertical portion of the frontal bone. In these cases the sinus is best exposed in the region where the frontal bone meets the nasal bone and the nasal or frontal process of the maxilla. Indeed, in adults where the frontal sinus exists in duplicate of the type shown in Fig. 4, it may be necessary to open the ventral sinus to get to the one dorsal in position. The skiagram is of great value in determining the presence or absence and extent of the frontal sinus in the region of the forehead, *i.e.*, in the vertical portion of the frontal bone. Where



FIG. 6.—From an adult male. Note the very diminutive frontal sinuses. Compare with Figs 1, 2 and 3.

supernumerary frontal sinuses exist and where the sinuses are of the orbital type, even skiagraphy may furnish erroneous results. Of course, rhinoscopic examination is an invaluable supplement in the diagnosis. Electrical transillumination is unreliable.

The clinician must bear in mind that there is no unvarying typical type of frontal sinus. Great variations are encountered. Agenesis of the frontal sinus is rare; duplication and triplication common. The diseased sinus may be the one dorsal in position and orbital in type. The skiagram may not reveal it. In some cases the frontal sinus is entirely absent in the vertical or frontal portion of the frontal bone, but present and roomy in the orbital or horizontal portion, hugging closely the ethmoid labyrinth and extending far dorsad and laterad into the roof of the orbit.

# TOOTH GERM CYSTS OF THE JAW

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THE subject of cystic tumors of the jaw has been considered quite extensively by Bland Sutton,<sup>1</sup> Kaufmann,<sup>2</sup> Bloodgood,<sup>3</sup> Scudder,<sup>4</sup> and others. The conventional terms applied to these cysts are, in our estimation, inadequate and misleading, since they neither designate the origin nor describe the clinical character of the tumor.

We shall, therefore, divide the cystic tumors of the jaw into, (*A*) inflammatory cysts, (*B*) tooth germ or chorioblastomatous\* cysts. The cysts of class *A*, generally called dental and root cysts, will not be considered in this paper because they do not originate in the embryonal epithelial remnants of the enamel organ as claimed by Magitot.<sup>6</sup> We fully agree with Partch<sup>7</sup> that these cysts are of inflammatory nature. Whether or not the wall of the cysts is lined by epithelium, as described by Turner,<sup>8</sup> is immaterial. Suffice it to state, they invariably originate in a periodontitis, as a result of which a granuloma forms. With softening and breaking down in the centre of the granuloma, a cyst follows. Should there by chance be present remnants of the epithelial cord of the enamel organ, they will become included in the granuloma, and this undoubtedly accounts for the epithelial lining of some of these cysts, the prime cause of which is, however, an inflammatory process.

The true tooth-germ cystic tumors that we have put into class *B* are divided into the (*a*) unilocular cyst, commonly known as the dentigerous or follicular cyst; and (*b*) multilocular cyst, conventionally designated as adamantine epithelioma, multilocular dentigerous cyst; and (*c*) the solid tumor.

These cysts of the jaw are rather of infrequent occurrence. We have been able to collect for our study six cases of this type; three cases from the surgical material of Dr. A. P. Condon, Nicholas Senn Hospital, and three cases from the material of Dr. Frank J. Hall of

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\* By the term Chorioblastoma, Albrecht<sup>5</sup> designates all tumors that are derived from embryonal rests.

## TOOTH GERM CYSTS OF THE JAW

Kansas City, Missouri. (I wish to express my thanks to these men, not only for access to their material, but also for much kindly advice and criticism.)

These cases form the basis of the present writing.

The embryonal cysts have a positive relationship to that part of the epithelial cord that does not enter into formation of the enamel organ, the "*débris épithéliaux paradentaires*" of Malassez.<sup>9</sup> This view, originally proposed by Falkson<sup>10</sup> and later confirmed by Malassez,<sup>11</sup> Kruse,<sup>12</sup> and others, is undoubtedly the correct one. However, there are some who deny the embryonal origin of these tumors. Bland Sutton<sup>13</sup> and his school believe that the multilocular cysts originate from the oral mucous membrane, for were they derived from embryonic enamel organ, they would have occurred at an earlier period. This argument against the embryonal theory of the cysts, we believe, is not well founded, for other tumors that arise from aberrant embryonal tissue, *e.g.*, hypernephroma, occur in persons past middle life and not necessarily in youth. Again the histopathology of the tumor speaks against the above assumption, as it will be described below in one of our cases that there was a distinct formation of dentin, which property can hardly be ascribed to the oral mucous membrane (Fig. 8). That these tumors are not endotheliomas will be pointed out in the differential diagnosis. That both the unilocular and multilocular cysts originate from one and the same source is evident from their concomitant occurrence; and, as it will be mentioned in one of our cases, one half of the cyst presented the picture of a unilocular cyst while the other half that of a multilocular (Fig. 5).

Our case of simple unilocular cyst had a distinct adamantine epithelial lining which strengthens this assumption (Fig. 2). Barrie<sup>14</sup> has described a similar case of unilocular cyst with an adamantine lining. Why in one instance aberrant epithelium will form teeth and a unilocular cyst, and in another a multilocular with more solid parts, is difficult to explain. One finds a similar condition in the ovarian cystoma; where, in one case, there is a simple, smooth-walled cyst, and in another, or, very frequently, in parts of the same cyst, a marked proliferation of epithelial lining, with the formation of well-sized solid masses, which may completely fill out the greater part of the cyst.

The recent anatomical work of Cryer<sup>15</sup> upon the mandible as a possible explanation for the multilocular character of these cysts will be touched upon later.

The course of development of the unilocular cyst is well illustrated by the following case:

CASE I.—Mrs. T. S., aged twenty-three, was operated upon at the Nicholas Senn Hospital, February 18, 1913. She had a swelling that she had noticed for six months in the left lower jaw, back of the second molar tooth, and a constant dull pain for the past few weeks.

An incision was made over the swelling from within the mouth and the bony wall of the cyst was chiseled away, a tooth removed from the depth of the cyst, and a lining membrane, about 2 to 4 mm. in thickness, was peeled out of the cystic cavity. She left the hospital well on March 1st. No recurrence was reported (Fig. 1).

*Pathological Report.*—Size of the cyst is twice that of a large olive; cyst contains a thick, colloid-like material, blood-tinged. The walls of the cyst are thickened, and at the bottom there is lying free in the cavity a molar tooth, which appears to be well developed.

*Microscopical Report.*—The wall of the cyst consists of connective tissue stroma containing many blood-vessels. The inner surface of the wall is lined by a layer of epithelium of adamantine type. The basal cells have a spindle nucleus; the cells nearer the superficial surface show the stellate adamantine form which conveys the impression of mucoid tissue (Fig. 2).

The unilocular cysts may occur at any age. Brophy<sup>16</sup> has seen only 12 cases of such cysts associated with deciduous teeth. They are found more frequently, however, during, or after, second dentition; rarely after 30 years. The usual seat of their location is the region of wisdom or bicuspid teeth, which fail to erupt. Both jaws are affected with equal frequency. The tumor is benign in character and runs a long course. The prognosis in these cases is good, as no recurrence follows after a complete excision of the cyst.

The multilocular chorioblastomatous cyst of the jaw is of less frequent occurrence than the unilocular. Lewis<sup>17</sup> has collected 70 cases from the literature. Since then, New<sup>18</sup> has added 8 more cases. With the report of 4 of our cases of this type, the total would be 82 cases. By far the most common seat of involvement is the molar region of the lower jaw. Only in 9 instances have they occurred in the upper jaw (New). In our series the seat of involvement in one instance was the upper jaw and three occurred in the lower jaw. Although Massin<sup>19</sup> has described the occurrence of such a tumor in a new-born infant, and Coots<sup>20</sup> observed one in a child 5 months old, yet the age at which they commonly occur is between 20 and 40 years. The oldest case on record was 75 years old (Lewis).



FIG. 1.—Case I. X-ray of unilocular cyst of jaw. Tooth seen in the cavity of the cyst.





FIG. 2.—Case I. Photomicrograph showing the adamantine lining of a unilocular cyst.



FIG. 3.—Case II. Multilocular chorioblastomatous cyst of jaw before operation.



FIG. 4.—Same as Fig. 3, after operation.



FIG. 5.—Case II. Multilocular and unilocular cyst of jaw (gross specimen).



FIG. 6.—Case II. Photomicrograph showing epithelial villi and cysts.

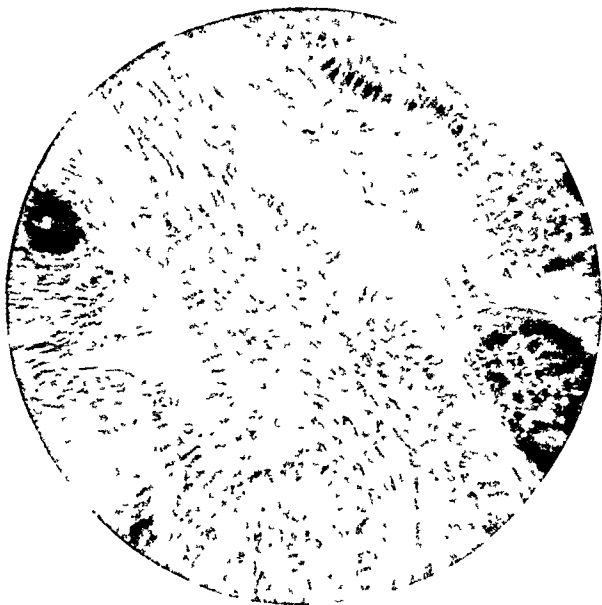


FIG. 7.—Case II. Photomicrograph showing part of a villus. Note the cylindrical cells in the outer layer and the stellate shaped cells in the centre.

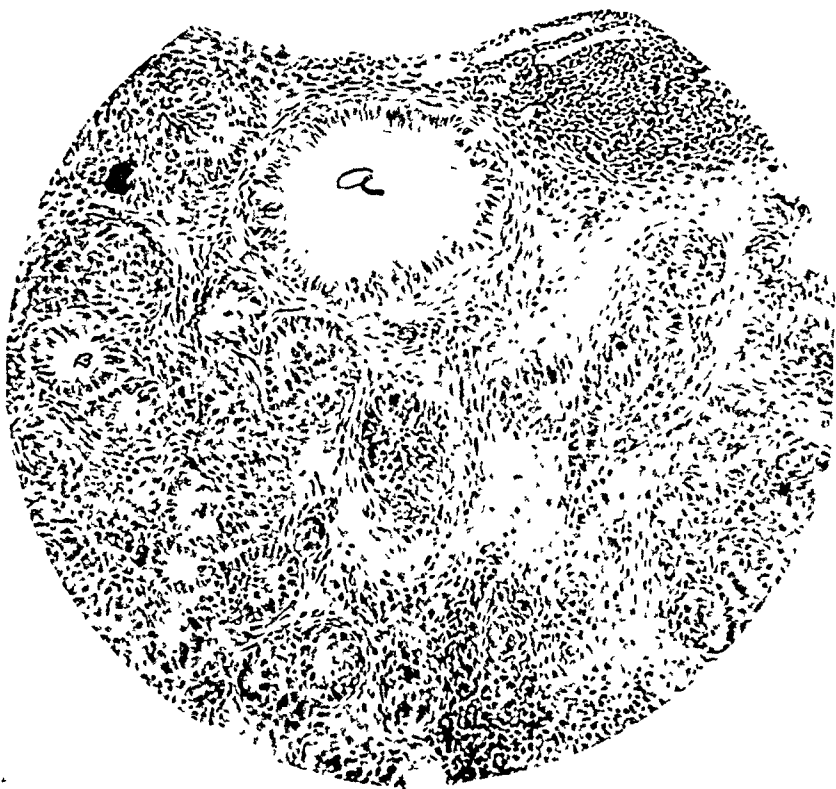


FIG. 8.—Case III. Photomicrograph showing dentine formation *A* and *B*.



FIG. 9.—Case V. Photomicrograph showing the formation of epithelial cords surrounded by cement.



FIG. 10.—Case VI. Photomicrograph of section of solid tooth-germ tumor in upper lip.



## TOOTH GERM CYSTS OF THE JAW

The growth of the tumor is very slow, as illustrated in the following cases.

CASE II.—Miss A. C. entered the Nicholas Senn Hospital on Tuesday, July 22, 1913, with the following history: Age 42 years, unmarried. Twenty-four years ago a swelling began in the lower jaw on the left side in the molar region. About nine years ago it was about half the size it is now and was operated upon by another surgeon. The patient says the surgeon told her it was a sarcoma and could not be removed. Following this operation a sinus kept discharging and a year later was operated upon by a different surgeon and piece of the wall of the tumor taken out, she says. The tumor remained about the same until three years ago and it began to grow rapidly.

Upon examination the tumor presented a solid growth, extending to the hyoid bone and well up into the temporomaxillary articulation. The whole mass had a bony feel, excepting the part near the lobe of the ear, which had a tense cystic feel. The mass extended a finger's breadth above the lobe of the ear. There was no ulcerated area.

The patient was operated upon July 26th. The jaw was cut through at the symphysis and disarticulated at the temporomaxillary joint. She left the hospital August 16th and has since remained well (Figs. 3 and 4).

*Pathological.*—The tumor is size of man's fist enclosed within a thin bony wall of the lower jaw. Tumor has a honey-comb appearance. The small cysts are filled with a gelatine-like fluid. The solid parts of the tumor are of rather soft consistency and of grey-white color. One-half of the tumor presents a single cyst, size of a small hen's egg, having smooth walls and is filled with thick gummy substance. There being no direct communication between it and the multilocular part of the tumor (Fig. 5).

*Microscopical.*—Sections taken from solid parts of tumor show a connective tissue stroma which is poor in blood-vessels. In the stroma there are found epithelial villi which form interlacing twigs having the picture of an epithelioma. The villi are made up of an outer layer of cells which are cylindrical and placed perpendicular to the stroma. Centrally from this layer there are cells of cubic shape and some are flat. In the centre of some of these villi there are interlacing stellate shaped cells. In other parts of the tumor there are macroscopic and microscopic cysts of varying size. The cysts are lined by similar cylindrical and flattened cells. Inside the cyst there is contained granular degenerated material (Figs. 6 and 7).

As Steensland<sup>21</sup> has suggested in the study of his cases that the cylindric cells correspond probably to inner epithelial layer of enamel organ and the cubic cells to the outer epithelial layer. The flattened

cells are likely the precursor of the stellate cells of the stratum intermedium. Section taken through wall of outer half of tumor of Case II shows a dense connective-tissue wall, within which are found solid masses of epithelial cells. The inside of the cyst is lined by epithelial cells of adamantine type.

CASE III.—Miss A., 20 years old; tumor noticed for the last 4 years. Tumor located in the upper jaw of right side at the first molar region. No teeth erupted through the gum over the tumor. The tumor was slow and painless. Opposite side presented an accessory molar tooth erupting behind the normal teeth. Tumor excised and no recurrence reported.

CASES IV and V.—The tumor occurred in the lower jaw. Duration of growth was several years. One of these cases occurred in a female and the other in a male, aged twenty-eight. We regret that a more definite clinical history could not be obtained since we lost track of these cases.

The Cases III and IV present a pathologic picture similar to Case II, except that in Case III there is marked formation of dentin (Fig. 8).

Case V differs from the rest. The epithelial structure of the tumor is continuous with the epithelium of the gum. This tumor might be mistaken for a true malignant epithelioma. However, the tendency of the epithelial cords to be surrounded by true cement formation and the appearance of cells obviously attempting to form stellate adamantine, stamp the character of the tumor (Fig. 9).

The pathogenesis of this type of tumor has been dwelt upon above. Its multilocular character can be probably explained by Cryer's work<sup>22</sup> who demonstrated the "inferior dental canal to be a cribriform structure; that an abundant communication exists between the vacuoles or loculi of the cancellated tissue of the bone; that the alveoli of the teeth are not only in communication with the inferior dental canal but with the loculi of the cancellated tissue in all directions and with one another through the same channels."

We are inclined to accept this as a plausible explanation of the nature of the above tumor. Since one can readily understand that a large single cyst, in which the epithelial lining is undergoing a marked proliferation with formation of solid masses, may become multilocular by the growth following the communicating canals. If this view be correct one can explain the recurrence of these tumors after incomplete excision.

## TOOTH GERM CYSTS OF THE JAW

Multilocular embryonal cysts are benign in character although as we mentioned they may recur if excision is incomplete. In our cases no recurrence is reported, the oldest being 6 years after operation.

Solid tumors, arising from rests of the adamantine epithelium, are of great rarity. In the case to be described below a tumor of this kind occurred in the upper lip.

CASE VI.—Young man, age 25. Had a small cherry-sized tumor in upper lip. Tumor was easily shelled out.

*Pathological.*—Size of tumor, that of a cherry—encapsulated. Hard consistency.

*Microscopical.*—Same picture as described under Case II except that the solid masses were in greater preponderance than in Case II.

After careful search of the literature I was unable to find a single instance of adamantine tumor occupying the position above indicated.

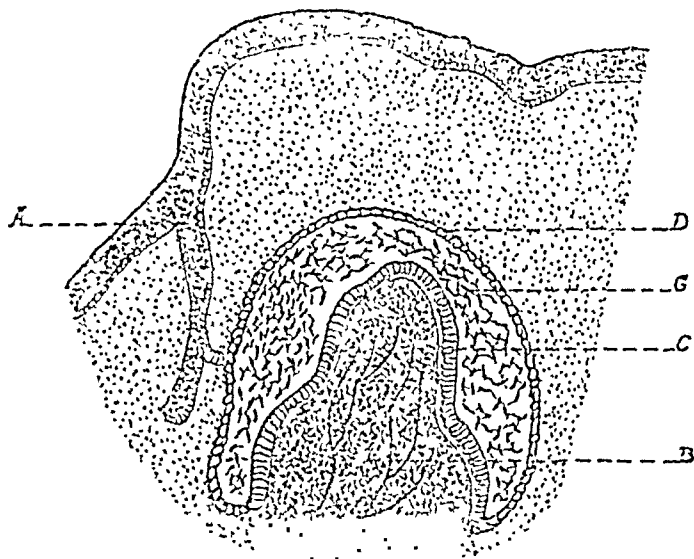


FIG. 11.—Schematic representation of the embryology of a tooth (after Kaufmann). A, epithelial cord; B, tooth papilla; C, inner layer, cylindrical cells; D, outer layer, cubical and flat cells; G, stellate reticulum.

Cases of unilocular embryonal cyst were reported to occur in the gums and orbital region. The unusual position of the tumor can be explained by the embryology of the teeth (Fig. 11).

The epithelium over rudimentary alveolar process dips down into mesodermic connective tissue and constitutes the epithelial cord, A. From the epithelial cord the future enamel organ is formed. The enamel organ becomes invaginated by the underlying mesoblastic tissue and this forms the tooth papilla from which dentin, cement, and tooth pulp are produced, B. The bell-like enamel organ possesses three



kinds of cells; the inner cells, tall and cylindric, *C*; outer layer cells, which are flat and cubical, *D*; the layer between the two consists of stellate reticulum, *G*, stellar cells which anastomose with each other and form mucoid tissue.

Only the upper part of the inner layer of cells which invests the tooth crown is capable of producing enamel. The cells at the lower part of the enamel organ lose property to produce enamel and grow deeper into mesoderm, forming a covering for the root of the tooth. By and by, this epithelial covering becomes absorbed and replaced by mesodermic cells. However, epithelial rests remain in the embryonic jaw. Malassez found such rests in most of the cases studied by him. One can readily see how epithelial tissue may become dislodged into the under surface of oral mucous membrane, and, when aroused to activity, proliferate, forming a solid tumor, as was the case with our patient, Case VI. Or, when the tissue is displaced into the body of jaw, cysts form which may be unilocular or multilocular, depending upon the proliferation of the lining of the cyst. Of course, some other factor is necessary to explain why, after having been dormant for years, bits of aberrant adamantine epithelium take on active growth.

Probably, as Senn has suggested, trauma or inflammation plays a rôle by increasing the blood supply, which stimulates the cells to active proliferation.

*Differential Diagnosis.*—The points of diagnostic importance are: the clinical history of the case. The extremely slow and symptomless growth differentiates these tumors from sarcoma, endothelioma and myeloid tumor. The second point in the history is absence of teeth over area involved. Third point is the absence of infiltration and no fixation to the bone of jaw. The X-ray is of some diagnostic value as illustrated in Fig. 1.

Microscopical sections show cells of the adult type corresponding to the cells forming enamel and dentin; arrangement is in long strings and gland-like structures, the latter sometimes presenting dentin formation in the lumina of the gland-like masses. Intact basement membrane always found sharply demarked by cell masses and gland-like structure from surrounding connective tissue. The occurrence somewhere in these masses of the characteristic stellate cells. The great variation of cells found in adamantine tumors will differentiate them from endothelioma, in which the cells are a uniform shape and type.

# TOOTH GERM CYSTS OF THE JAW

## CONCLUSIONS

- 1.—The conventional terms employed for cystic tumors of the jaw are neither descriptive nor accurate.
- 2.—Cystic tumors of the jaw are divided into (*A*), inflammatory; (*B*), tooth germ (chorioblastoma)—(*a*), unilocular; (*b*), multilocular; (*c*), solid.
- 3.—Chorioblastomatous cysts of the jaw originate from the embryonal rests of epithelial cord of enamel organ.

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## TWO CASES OF THORACIC ANEURISM WIRED FOUR YEARS AND THEREABOUTS AGO RESPECTIVELY\*

WITH REMARKS ON THE ANTISPECIFIC TREATMENT AND THE OPERATIVE TREATMENT  
OF THORACIC ANEURISM

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THE following two cases of thoracic aneurism were presented before the New York Surgical Society two years and a half ago (ANNALS OF SURGERY, lix, 1914, p. 461, Cases II and III). Both cases after the wiring operation were given antispecific treatment, and they developed an ability to endure very severe exertion. Special attention is called to the need for treatment of aneurism with the antispecific remedies, which the writer believes should be administered in the way herein described in order to get good results.

CASE I.—V. A., bar-tender, present age forty-two. Referred by Dr. A. de Yoanna. The Moore-Corradi operation of wiring with electrolysis was performed on May 3, 1912. The patient had had pain for about one year prior to operation, which, from a time three months before operation for a period of one month, had been so great that he could not sleep. Just before the operation there was a steady pain in the right axilla and in the inner side of the right arm. The aneurism had eroded through the right second costal cartilage. Pulsation was not very forcible. No bruit. No respiratory symptoms. For a month prior to coming to the hospital he had been given mixed treatment with no apparent benefit.

At operation seventeen feet of the "clasp" gold wire No. 29, shaped in evenly curved loops from  $4\frac{1}{2}$  to  $5\frac{1}{2}$  inches in diameter, were introduced into the aneurismal cavity through an insulated gold needle. The electric current used was 100 ma. for seventeen minutes and 50 ma., 40 ma., and 30 ma., each for fifteen minutes. After thirty-five minutes of the electrical séance the pain had entirely subsided. During convalescence the pains were intermittent and of short duration. In the course of a month following the operation there was practically no pain unless from too much exertion. At the end of two months the patient could walk three or four short blocks without pain. He worked all that

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\* Cases presented before the New York Surgical Society, May 10, 1916.

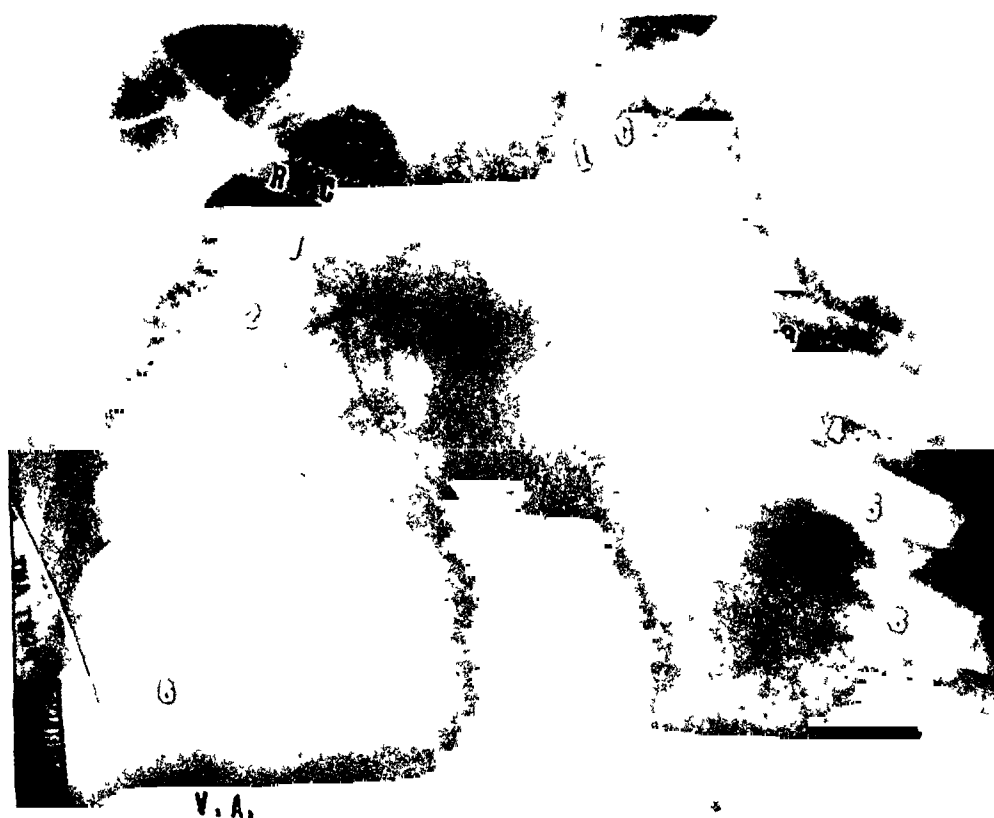
summer tending bar, having very little pain and that only occasionally. Antiluetic treatment was at first withheld in order to test the efficacy of the wiring operation of itself to relieve the pain. He began taking mixed treatment the end of May, 1912, and took the same pretty regularly until the following March. He thought when the mixed treatment was interrupted that he would have more pain, which would seem to leave again on his return to the medicine. With excessive exertion he would have a temporary return of pain. On February 26, 1913, it is recorded that he was daily walking up one flight of stairs four or five times, was on his feet seven or eight hours, was walking four to five blocks and suffering no pain. This was before he was given salvarsan. Between March 31 and November 28, 1913, he was given four injections of neosalvarsan, two of 0.3 g. and two of 0.45 g., two injections of salvarsan 0.3 g. and eleven intramuscular injections of the salicylate of mercury, in the course of which treatment his activity was greatly increased. On September 11, 1913, it is recorded that each day he would stand all day working as bar-tender, would lift 30 to 40 pounds about once and would walk about two miles. About twice a week he would have a little pain following exertion lasting about five minutes. On November 18 of the same year, he stated that a quick walk for half a mile had excited a little pain. In the winter of 1913-1914 he and his brother, who also had a thoracic aneurism which was wired by the writer, went to Brazil, where for seven months they both peddled suits of clothes, carrying the same in packs on their backs, walking about six miles every day, stopping from house to house, being thus engaged about six to seven hours a day, each carrying a pack weighing at the beginning of the day about 50 pounds. Neither of them had any pain during this time. They were some of the time at Rio Janeiro, which is a hilly city. In the fall of 1914, while in Italy, two or three times this patient walked six or seven miles on the level without pain or any difficulty. In the past fifteen months (prior to May 10, 1916) he has been the proprietor of a restaurant in a neighboring city, and has done no particularly hard labor. He walks habitually twelve blocks a day and on Sundays he walks about two miles slowly. In the past fifteen months he has had no pain in the right side of his chest, except three months ago he had an attack of pain in this locality as well as in the right upper extremity lasting about two minutes accompanied by dizziness and pallor, and two weeks ago he had a second similar attack lasting three or four minutes. During the past winter every day he carried up two pails of coal from the cellar, two flights, one pail in either hand, each weighing about 25 pounds. There was no ill effect from this work. In the winter of 1913-1914 he took a

bottle and a half of mixed treatment and in the spring of 1915 three bottles more. He has had no treatment since. His Wassermann, at first negative, in April, 1913, was found to have become positive and in September, 1913, was very strongly positive. In over two years the patient has been seen only twice by the writer.

CASE II.—G. S., machinist, present age fifty-two years. Referred by Dr. Leon T. LeWald. In March, 1910, he began to have pains in his chest. In April, 1911, he noticed a lump in his chest and the pain became continuous day and night in the front and back of the left side of his chest and in his left arm. The pain was very severe so that he could hardly sleep and he groaned with the pain. In June, 1911, he went to a hospital where as a result of resting and the taking of potassium iodide for four weeks, he improved so much that he was able to return to work on a radial drill, at which employment he then continued until July 3, 1912. During this time he had pain only when he worked, but not at night until about the middle of June, 1912, when the pain came on at night as well, but was not so severe as it had been the previous year. In fact, at that time he was able to sleep four or five hours at night. He had no shortness of breath. He had to scrape his throat a little. The aneurism could be readily felt pulsating in the left second and third intercostal spaces as far as to three inches from the median line and faintly in the first space. In the second space the aneurism was very tender. On July 8, 1912, he walked about three miles.

*Operation* (July 20, 1912).—About  $22\frac{1}{2}$  feet of No. 29 "clasp" wire, shaped in evenly curved loops 6 to  $7\frac{1}{2}$  inches in diameter, were introduced. The current used was 100 ma., 50 ma., 40 ma., and 30 ma., each for fifteen minutes. Just before the operation the patient, when resting, had had but little pain, so that no marked immediate effect from the operation was noted. The second night following the operation the patient was conscious of a marked diminution in the pulsation and he began lying on his right side which previously he had been unable to do. After five weeks in bed he soon was climbing three flights of stairs (not by advice) without trouble, and on September 20 he easily lifted one end of a 150 pound weight.

The interesting feature of this case is the considerable amount of labor that he has been able to perform. Excessive exertion has frequently brought on temporary pain which has always gone away with stopping the physical effort. The attacks of exacerbation of coughing with considerable expectoration have usually come on following exposure to wet. There has never been pressure on the trachea causing any obstruction to the breathing.



**AFTER OPERATION**

FIG. 1.—Patient V. A., after the wiring operation. (Taken by Dr. Byron C. Darling.)

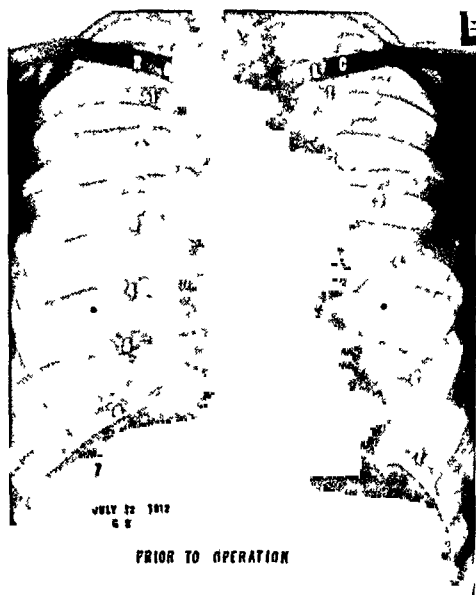


FIG. 2.—Patient G.S. X-ray of July 22, 1912, before operation. Direct anteroposterior view. (Taken by Dr. Leon T. LeWald.)



FIG. 3.—Patient G.S., after the wiring operation. Exposure slightly oblique so that the shadow is thrown a little more to the left than it would have been in a direct anteroposterior view. (Taken by Dr. Byron C. Darling.)



FIG. 4.—Patient G.S. July 30, 1914. Direct anteroposterior view. Compared with Fig. 2, it shows about  $\frac{1}{2}$  an inch increase in transverse diameter of the aneurismal shadow since before the operation. (Taken by Dr. Leon T. LeWald.)



FIG. 5.—Patient G.S., May 28, 1916. Exposure slightly oblique, so that the aneurismal shadow is pitched a little too far to the left for a comparison of its size with that of the shadows in the direct anteroposterior views. Small area of bulging to the left. (Taken by Dr. Leon T. LeWald.)

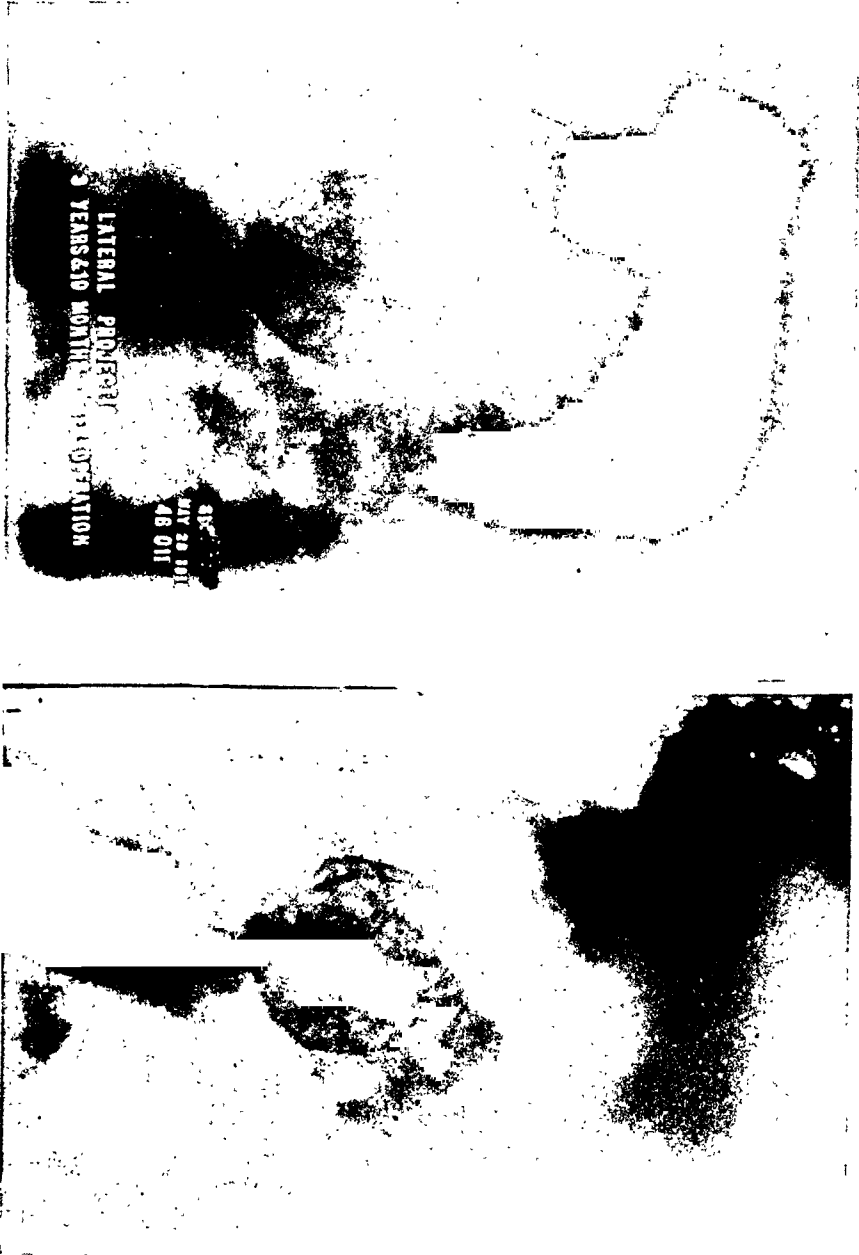


FIG. 6.—Patient G. S., May 28, 1916. Stereoscopic X-ray of the wire, viewed from the side. Size for hand stereoscope  
(Taken by Dr. Leon T. LeWald.)





That this patient has been able to put forth such exceeding physical effort would seem to indicate that the wiring operation and the arrest of the aortic disease by the medication had together strongly fortified the aneurism wall. The patient has frequently mentioned that the taking of coffee has seemed to give him pain. Also he has sometimes attributed the pain to gas in his stomach. Pain in his chest following the taking of food is relieved by belching gas. Figs. 2, 3, 4 and 5 show X-rays of this aneurism at different periods of time.

Antispecific treatment was withheld until September 30, 1912, when mixed treatment was begun and taken for six weeks out of every eight up to March 15, 1913. Between January 10 and February 16, 1913, he was given 3 doses of neosalvarsan 0.3, 0.45, 0.6 g., following which his activities became very much increased. He seemed to experience the most decided improvement, however, the middle of March on stopping the mixed treatment, when he observed that he felt stronger and that practically all pain left. Two weeks later on beginning mixed treatment again, pain returned, but on stopping this medicine it again went away. The writer has noticed an apparent intolerance for potassium iodide for a time after one of the salvarsan preparations has been given. Wassermann on February 16, 1913, had become negative and was still so on the following May 12.

The patient returned to work, taking up his former job on the drill press, the end of October, 1912, up to which time he had been having a little pain lasting a few minutes four or five times a day. He kept at this employment for a week, having pain most of the time while at work. For three or four weeks in November and December the effort of lifting gates at a railroad crossing by means of a crank, at first caused only a little pain, but with stiffening of the machinery he was obliged to relinquish the job. Two days after stopping this work the pain entirely left. Prior to receiving neosalvarsan he would have a little pain if he walked as much as half a mile in fifteen minutes. On February 6, 1913, eleven days after his second dose of neosalvarsan, he walked about eleven miles without a symptom. On the night of February 11, 1913, he cranked the railroad gates, which was pretty heavy work, having no pain until the following afternoon. Early in the following March he worked in a machine shop where he had to lift about 20 pounds about every quarter of an hour for nine hours a day. Thus employed, for two days he had no pain, but on the third and fourth days pain ensued and he had to stop. On May 3, 1913, the record states that he was not working, but was daily climbing six flights of stairs to his room and walking five or six miles and had no pain or cough. On May 14 he worked eight and a half hours, carrying refuse cans weighing

about 100 pounds a distance of about 100 feet and loading them on a truck, and throwing bags weighing about 70 to 100 pounds down a chute. He had no pain but experienced heavy throbbing. On June 13 he spat up about ten mouthfuls of bright red fluid blood. The hemorrhage subsided. In the summer of 1913 he had pain only on occasion from excessive effort. Thus in August he was employed where he used an 18-pound sledge hammer at intervals, and was obliged to lift about 100 pounds. He worked at this job five days and left because he had a little pain which lasted only about one day. A job at heavy filing ten hours a day caused a little pain while at work. September 2, he got a job in a machine shop running a big radial drill where he had to lift 30 to 50 pounds several times per day. He had had no pain after eight days of this work. With a view of reducing his physical effort, he was then sent, with the coöperation of Dr. Warren Coleman, to the Sharon Industrial Home for Cardiacs, but he soon went back again to work on a drill press, where this time, however, the work was lighter, he usually not having to lift more than five or six pounds.

In the fall of 1913 his Wassermann having become positive again, further antisppecific treatment was administered. Between November 30, 1913, and March 29, 1914, he was given 14 intramuscular injections of mercury, and on January 18, 1914, neosalvarsan 0.45 g. From March 16 to August 10, 1914, excepting for three weeks, he was given potassium iodide grs. v to vii or mixed treatment t. i. d. For three weeks in September and October he returned to the potassium iodide but he finally complained of its giving him pain in the stomach so that it was stopped.

Between November 18, 1913, and February 7, 1914, he worked off and on doing the lighter work on the drill press, having but very little pain and that only while at work. He would go for intervals of several days at a time without any pain at all. There was no immediate improvement noticeable following the neosalvarsan on January 18, 1914. On January 24, 1914, he had no cough or expectoration. His cheeks were rosy and his general health excellent. On February 19 he got wet and caught cold and had cough with expectoration until the end of March, the cough continuing into May. From February 7 to August 15 of this year he did but little work. In June he worked seven days on a drill press, lifting weights up to 75 pounds without having any pain. Notes of July 18, 1914: Has had no pain in about six weeks, he last having had a little after a ten-mile walk. Has had no cough since early in May. Whenever he is out of work he walks from six to eight miles a day. His health is excellent. These notes were made at a time when he had been practically out of work for five months, though he had walked considerably, and after having taken potassium iodide pretty steadily for four

months, following a long course of mercury injections given during the winter and one dose of neosalvarsan in January. He got over his cough in May while he was taking potassium iodide. On August 15, 1914, he sailed for Liverpool as seaman on the "Saxonia" and later returned on the "Lusitania." On this trip he carried food cans weighing about 20 pounds, scrubbed forecastles, pulled on hoisting-ropes, and for about one hour handled trunks. During the latter job he had a very little pain, which subsided as soon as he stopped working, otherwise the pain he experienced on this trip was insignificant. On the "Lusitania" he got wet and, having to live in his damp clothes for two or three days, caught cold. He then had cough with thick expectoration in the mornings. His cough continued into November. Around December 5, 1914, he was usually not coughing. From October 5, 1914, to January 5, 1915, he worked on a drill press, which labor, though light, was for long hours. Through the fall up to the middle of December, 1914, he had practically no pain. Then he caught another very bad cold and pain in his chest returned, the pain generally lasting for short periods of time and recurring at intervals of one or more days. After he stopped working in January the pain soon left. While out of work he walked several miles a day. On returning to light work in an automobile shop he had some recurrence of pain.

In January, 1915, he took potassium iodide, grs, v t. i. d., on stopping which his cough got a good deal better. Between November 7, 1914, and January 9, 1915, he was given seven injections of mercury salicylate.

On February 27, 1915, he embarked again on the "Lusitania" as a seaman and returned to New York May 24, during which time he had only one attack of pain and that while working ashore, as a result of which he went to a hospital where he spent three weeks. On his return from abroad he had a cough. He then took some more mixed treatment. After his return he did no work for at least a month. An occasional pain he had during this time he attributed to taking coffee. Around June 23, 1915, he was coughing only a couple of times on getting up in the morning and three or four times during the day.

In August, 1915, his Wassermann being 12 units positive as rigorous a course of antisppecific treatment as his work would permit was instituted. On March 16, 1916, his Wassermann was 5 units positive. Between August, 1915, and April 9, 1916, he was given fifteen injections of mercury salicylate,  $\frac{3}{4}$  to 1 gr. each, and on March 16 he was given diarsenol 0.3 g. He also took potassium iodide grs. x t. i. d. most of the time from about the first of September, 1915, to January, 1916. The end of Sep-

tember, 1915, his cough had entirely stopped, but on October 1 he got his feet wet again and caught another cold. About the first of January, 1916, on stopping the potassium iodide, the cough which had been pretty bad became much easier. About the first of February, on resuming the potassium iodide the cough became bad again, so that he stopped this drug and again the cough lessened. Since then no more potassium iodide has been given. After the middle of February the patient got his feet wet on shipboard and took cold, and cough and expectoration again became pretty bad. He now had two or three severe coughing attacks to raise thick expectoration every night. Immediately following the diarsenol on March 16, 1916, the expectoration became thin and much reduced in amount and the cough became much less severe, the night attacks ceasing. Around April 9 his cough was less and he was having only a little expectoration mornings. However, on April 17, with a sudden change of temperature in the work-room, he again caught cold and began again to cough a good deal and to expectorate thick phlegm. While his cough was pretty bad up to the middle of May, disturbing him at night, it then improved so that he coughed only on awaking in the mornings to raise expectoration and very little in the daytime. His own notes state that for two weeks after receiving the diarsenol he had a slight pain at night lasting one-half to one hour. In the month following the taking of this drug he lost six pounds in weight, yet in this time his cough and expectoration had greatly decreased.

In August and September and again in November and December, 1915, he worked on a drill press. On January 24, 1916, he made a trip to Liverpool on a cattle-ship where he carried hay and water to feed the cattle. About the first of March he obtained employment as a marine machinist in which capacity he had to lift up to 20 to 30 pounds. On March 10 he carried about 50 pounds of coal up three flights of stairs without stopping, which made him a little short of wind. March 14 he walked a mile in seventeen minutes. On March 27 he walked about five miles, carrying his tools for two of the miles, and during the last mile he had a little pain over the aneurism. During a part of April, 1916, he worked on a light drill press. From May 1 to May 27, notwithstanding his cough, he put forth great effort. He worked overhauling ship pumps, lifting generally weights of from 10 to 20 pounds, but four or five times a week he would lift a weight of 80 to 100 pounds. On three of these days he did 14 hours of actual work and on nine days 12 hours of actual work. During the last two weeks on this job his cough and expectoration became greatly improved. During the whole time on this job,

he had only very occasionally a slight touch of pain, lasting about five minutes. On June 3, the patient reported that he was obliged to eat four meals a day to satisfy his appetite. Examination of sputum for tubercle bacilli on May 30 was negative. No signs of apical lesions.

During the past summer (1916) the patient has practically done no work. He took red iodide of mercury pills for about eight weeks. August 24, 1916, Wassermann negative. Toward the end of September he shipped as a deckhand on the "St. Paul." On this trip he had no pain while at work. He was last seen on November 3. Since early summer he has had some cough which has been for the most part dry. During this time except in the hottest season, he has generally walked several miles a day. Often after walking 2 or 3 miles he has had a little touch of pain, which has gone away with resting and to which he has paid little attention. He claims that the eating of fried eggs gives him slight pain. He is looking and feeling very well and has a big appetite.

LATE NOTE.—The patient dropped dead on the street November 16, 1916. Autopsy showed intrathoracic rupture of the aneurism. The aneurism specimen has not yet received a thorough examination.

The writer is indebted to Dr. George B. Wallace for his coöperation in the care of this case.

*The Antispecific Treatment of Thoracic Aneurism.*—The writer wishes to emphasize the importance of treating the syphilis in thoracic aneurism, as a means of controverting the symptoms and prolonging life. The antispecific treatment must be administered according to rule<sup>1</sup> to obtain good results. The writer's rule is that potassium iodide and mercury must first be administered for four or five or six months before one of the salvarsan preparations or diarsenol is given. Lesser,<sup>2</sup> of Berlin, states that in treating tertiary syphilis potassium iodide and mercury should always precede the administration of salvarsan. The mercury should preferably be administered by intramuscular injection. The preliminary treatment with the older remedies, combined with rest, has, in not too advanced cases, for a time anyway, attained much for the relief of the symptoms. It is, however, following a long preliminary treatment with potassium iodide and mercury, after one of the salvarsan preparations or diarsenol has been given, that a further betterment is very promptly effected, which is more enduring than that

<sup>1</sup> Lusk: Discussion on Thoracic Aneurism. N. Y. Medical Record, March 27, 1915, p. 540.

<sup>2</sup> Lesser: Berl. kl. Wochenschrift, March 16, 1914, p. 494.

which can be obtained with potassium iodide and mercury alone. Any cough then diminishes, and pain, if present, is lessened or vanishes and the patient becomes possessed of a sense of well-being not before experienced. In two cases of thoracic aneurism, to whom small doses of salvarsan were given as their chief treatment, at intervals over a period of several months, without the preliminary use of potassium iodide and mercury, the symptoms became aggravated and the patients died. It would seem probable that it is the preliminary control of the gummatous infiltration of the aortic wall by the potassium iodide and mercury which gives particular efficacy to the spirochæta-cidal action of the subsequently given salvarsan or diarsenol. In the observation of the writer, in cases of thoracic aneurism pretty generally, it has seemed that, for some time after salvarsan or diarsenol has been administered, if potassium iodide were given, pain would result or cough and expectoration, if present, would be increased. He therefore always stops potassium iodide before giving salvarsan or diarsenol and withholds it for a considerable time thereafter. To one case of thoracic aneurism with a cough, who had had no salvarsan for as long an interval as a year, small doses of iodulose were administered, the giving of which was attended with a marked exacerbation of the cough which became very distressing at night. However, on stopping the iodulose, the aggravation of the cough at once disappeared.

Mercury should be omitted for five days before and for five days after the administration of salvarsan or diarsenol for fear of kidney complications. After one of the latter drugs has been given, mercury seems to take on a renewed efficiency. The writer repeats the salvarsan or diarsenol about once a month, being guided as to the number of injections given by the Wassermann reaction, and in between doses he gives mercury again under the precautions above stated. It is these injections of mercury between the injections of salvarsan or diarsenol that seem to give added recuperation to the patient. The writer had until the past winter used neosalvarsan 0.45 g. since Alwens<sup>3</sup> had shown experimentally that neosalvarsan given in proportionately large doses to rabbits was little liable to produce nephritis, while old salvarsan in lesser dosage was very liable to do so. He now uses diarsenol 0.3 g. with which the results in the few cases treated have been entirely satisfactory.

The use of the diarsenol, which is supposably the equivalent of old salvarsan, has seemed to be more generally effectual than was the neo-

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<sup>3</sup> Alwens: *Archiv. f. Experiment. Pathol. u. Pharmak.*, Bd. 72.

salvarsan. When, after the primary series of salvarsan or diarsenol has been given to these cases, it becomes necessary to give a subsequent course of antisppecific treatment, if potassium iodide cannot be taken, a course of mercury alone should precede the giving of the salvarsan or diarsenol.

The writer administers the potassium iodide in doses of not over 10 grains t. i. d. He uses the salicylate of mercury for intramuscular injection in doses of not more than one grain, repeating the same generally at five-day intervals. He would call attention to the facts that abdominal cramps and diarrhoea following an injection of mercury are indications for reducing the dose, and that fetor of the breath or swelling of the glands of the neck with perhaps swelling of the tonsil, too, are just as much indications for interrupting the mercury as is soreness of the gums and teeth. With the giving of the diarsenol or salvarsan, the condition of the urine should be watched with particular care.

Without the antisppecific treatment in cases of thoracic aneurism, the relief of symptoms coming on as a result of the wiring operation lasts only for a short time, because the disease in the arterial wall remains unchecked and the aneurism will consequently resume its growth.

In trying to estimate the effect of treatment on the growth of the aneurism in the case of G. S. herein reported, from X-ray plates, it must be noted that of the four illustrations of this case grouped together, Figs. 3 and 5 do not furnish outlines for accurate comparison with the others, since they were taken a little obliquely and therefore throw the shadow a little farther to the patient's left than a direct front to back picture would have. Figs. 2 and 4, however, being both direct anteroposterior views give a fair estimate of the change which had taken place two years after the operation, which consisted in a broadening of the shadow about half an inch as measured in the original plates. The X-ray of May 28, 1916 (Fig. 5), shows a small area of bulging to the left, not before observed.

The patient G. S. has been given considerable potassium iodide. That which he took soon after the operation and before getting his first neosalvarsan was undoubtedly highly beneficial and very necessary. Continuing his mixed treatment during the time he was getting his first three doses of neosalvarsan and for a month thereafter, he seemed to get his greatest benefit following the neosalvarsan, after the mixed treatment had been stopped. This is in keeping with the theory of incompatibility between potassium iodide and the salvarsan preparations.



In the fall of 1913 there was referred to the writer by Dr. C. D. Van Wagenen a case of aneurism of the aortic arch,<sup>4</sup> whose X-ray picture at that time compared with one taken at the same focus and in the same position 16 months earlier, showed a lateral shrinkage in the aneurismal shadow of from 1 to 1¼ inches to have taken place. Also it was found that the physical signs of aneurism of the aortic arch, which has been present in this patient, no longer existed. All the treatment this patient had had was rest, small doses of potassium iodide given very irregularly and a few injections of mercury. Deducing from this result that potassium iodide might be able to cause diminution in size of an aneurism, beginning on March 16, 1914, the patient G. S. was given small doses of potassium iodide over a period of 5 months. This dosage was instituted just following a long course of mercurial injections and one dose of neosalvarsan given the preceding January. While the patient was taking this potassium iodide he practically was doing no work, though he walked considerably, and after the fourth month of this medication his health was excellent and he had no pain or cough. It was just about this time that the X-ray picture shown in Fig. 4 was taken. Besides this course of potassium iodide, he had had another one of particular length previously from September 30, 1912, to March 15, 1913, and received still another subsequently from about September 1, 1915, to about January 1, 1916. Following the course of potassium iodide given in the spring and summer of 1914, whenever resort was had again to potassium iodide he either had, or developed, a cough which would seem to be aggravated by this drug, since on stopping the latter the cough would always get better. Finally (February, 1916) further attempt to give potassium iodide was given up on account of its baneful effect on the cough. In some cases of thoracic aneurism, cough seems to be increased as a result of the long continued use of potassium iodide irrespective of the taking of salvarsan or diarsenol, the appearance of which manifestation probably signifies that the limit of tolerance to this drug has been reached. The X-rays show no evidence of gross shrinkage in the size of this aneurism as a result of the treatment.

In one other case, a mesially situated aneurism of the arch, in which careful comparisons were made of X-ray plates before and after a six-month interval in which the patient had rested and had received 29 injections of Hg salicylate from ½ to 1 grain, and small doses of potassium iodide for a large part of the time, the shadow was found to have remained the same size. This patient up

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<sup>4</sup>Lusk: *ANNALS OF SURGERY*, 1x, 1914, p. 535.

## THORACIC ANEURISM WIRED

to that time had had no diarsenol or salvarsan. Thus it can be argued that potassium iodide in small doses will not extensively diminish the size of an aneurism.

When one thinks about it, it is hardly to be expected that a diseased aorta considerably converted into adventitious tissue, which has dilated, can possibly become very much reduced in size, even under circumstances most favorable for the healing of the gummatous infiltration and the destruction of the spirochætes. A slight shrinkage however as a result of the control of the disease and the reduction of spirochætal activity, could explain the relief of symptoms following treatment. Yet the enlargement of the aneurism in the case of G. S. within the first two years following wiring (Fig. 4) would seem to indicate that a certain amount of accommodation of the surrounding tissues to the pressure of the tumor may take place. Recent descriptions of the pathological anatomy of syphilitic aortitis have been published by Symmers and Wallace and by Longcope.

The writer is inclined to believe that in cases of mesially situated aneurism of the aortic arch, who suffer from acute dyspnœic attacks associated with sudden great pressure on the trachea, and who become greatly alleviated or relieved shortly following the administration of morphine and atropine, the existence of a mediastinal œdema can be offered as a rational explanation of the sudden acute symptoms. There is usually in these cases an area of superficial veins on the upper part of the front of the chest which, like a tell-tale, remain congested while the symptoms are more or less acute. In a case of this sort recently treated medically, the paroxysms of acute dyspnœa were promptly relieved by a hypodermic of 10 minims of adrenalin, which result would favor the theory of a mediastinal œdema being the cause of the acute pressure on the trachea. Relief, which was marked and more lasting than that obtained by any other means, was given to this patient by an injection of neosalvarsan 0.45 g., which, however, came after considerable antispecific treatment had already been administered. In the case referred by Dr. Van Wagenen, the subsidence of a mediastinal œdema might explain the very large reduction in size of the X-ray shadow corresponding to the thoracic aorta.

Dr. G. Reese Satterlee<sup>5</sup> has reported a case of thoracic aneurism to whom he began to give antispecific treatment in May, 1911, and who, Dr. Satterlee advises me by personal communication, is to-day (June, 1916) living in comfort and doing light work. The patient was early

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<sup>5</sup> G. R. Satterlee: N. Y. Medical Journal, Jan. 13, 1912.

given two small doses of salvarsan, besides which to date he has had 125 intramuscular injections of mercury, and with the intermission of a year, he has been given 90 grains of potassium iodide a day continuously since treatment was begun. Dr. Satterlee, in his report, described a penumbra seen with the fluoroscope, lying to the left of the shadow of the arch, which he interpreted as being a probable "syphilitic deposit" skirting the aneurism. He says that a year ago the penumbra was still present, though of a lesser density than in the beginning.

*The Operative Treatment of Thoracic Aneurism.*—The antispecific treatment cannot be relied upon to cause strengthening of an aneurismal dilatation much weakened by stretching. It is to offset or to forestall the growth of a weakened aneurismal area of this sort that the Moore-Corradi operation of wiring with electrolysis is indicated, as a result of which, if a clot can be thrown down on the inner surface of the dilated area, a means of repairing the latter is thereby furnished which will rapidly bring relief to the symptoms, and will probably cause shrinkage of the local tumor. Aneurisms not compressing the trachea, which are very large or prominent and therefore liable to rupture, are suitable ones for early wiring. The median aneurisms which press on the trachea with sufficient force to compromise the breathing are still a study. Unless too far advanced they seem to do well with the antispecific treatment alone. The writer has wired two of these cases. One of them, treated afterward with the antispecific remedies, lived for about  $3\frac{1}{2}$  years, and the autopsy showed that the wiring had accomplished nothing. The other case had a sacculum projecting above the manubrium, in which a clot formed as a result of the operation and the patient died soon after the operation from tracheal obstruction.

A principle in the technic of the wiring operation to be emphasized, is that of contact of as much as possible of the introduced wire with the inner surface of the aneurismal wall, since clot produced by the electrolysis in the course of the wire, in order to find permanent lodgment where it can undergo organization, must be deposited on vitalized tissue to which it can adhere. A coating of fibrin which is laid down by the electric current on that portion of the wire which projects free into the swiftly-moving blood stream soon becomes loosened from its attachment, leaving the wire bare. The localities within an aneurism where the blood is most likely to become clotted by an electrified wire, are where the aneurism is recessed, at which situations close to the aneurism wall the aortic blood current must be slowed to a greater extent than anywhere else. If no recess should exist, as in cases where the dila-

tation of the aorta might be a purely fusiform one, then the efficacy of the wiring operation would be in question, from the probable inability of a suitable clot to form in the presence of very rapidly-moving blood. In the case of G. S. the position of the wire shows that the first portion of the aorta was simply dilated to the left into a recess, the recess forming a part of the main conduit for the blood, thus demonstrating that the aneurism need not necessarily be a purely sacculated one for the wiring operation to be of avail. A recess would naturally correspond to a site of weakening of the aneurism wall, since it is at such situations that the most stretching has taken place. Consequently the recesses are the sites needing to be strengthened. Since the prominence of the aneurismal tumor, where the puncture with the insulated gold needle is made, generally indicates the site of a recess, the wire must be manipulated by shaping in such a way that some of the loops as they are introduced will come back so as to touch the area of sac wall adjacent to where the needle point has entered the cavity. In order to manipulate the wire from without in a way to control in a measure its arrangement within the aneurism, a resilient wire is used, the "clasp" gold wire<sup>6</sup> No. 29, which being properly shaped before operation, will after passing through the needle regain its shape within the aneurismal cavity. To favor the coming back of the wire during its introduction so as to make contact with the aneurism wall around the site of entrance of the needle, it was found by tests in a glass flask, that if a loop of the wire, shaped so as to have a smaller diameter than that of the flask, were interposed between about every two larger loops, having a diameter greater than that of the flask, than each smaller one, when first introduced, posing within the flask under little or no restraint other than that of the wire with which it was continuous, would tend to assume a position about in a plane passing through the long axis of the shaft of the needle. As the larger loops of the wire now followed each smaller one, the latter would become expanded as far as the confines of the cavity would permit, and, lying in the plane above mentioned, as it expanded it had to retrieve to alongside of the needle point. This interposition of smaller between larger loops of the wire has seemed to establish a varying direction for the loops, resulting in a more or less general peripheral arrangement of the wire than when the wire is shaped in loops all of a diameter which is larger than that of the aneurismal cavity.

In order to bring as much wire as possible into contact with the aneurism wall, the wire, first straightened, should be shaped in undulat-

<sup>6</sup> Lusk: A Thoracic Aneurism Treated with Gold Wire and Galvanism. ANNALS OF SURGERY, June, 1912, pp. 789-803.

ing curves, and then this undulated piece of wire again curved so as to form loops. The peripherally lying crests of these undulations have a better chance of making contact with the aneurism wall than a wire of one even curve would have, both by their being better able to fit the irregularities of the cavity and as well by being able to dip down through the interlacement of the loops of wire already laid down. In the last case wired, the crests of the undulations were somewhat flattened with a view of securing contact of a greater length of wire than could be gotten with a crescentic shape. The undulated wire allows more give and therefore takes a peripheral arrangement under less tension than does a wire curved evenly in large loops. Also the undulations as they interdigitate make a deeper mesh of wire to possibly aid in the entanglement of blood clot at the wall of the cavity. The entering extremity of the wire is always shaped in an expanding spiral so that it will come back toward the needle point as it enters the aneurism and lodge free in the central portion of the cavity. The portion of wire which is last introduced and which is to be left in the needle track after the needle has been withdrawn, should be straight, and the portion of the wire introduced just in advance of the straight piece should be shaped in a couple of very small loops which will lie free within the cavity of the aneurism, thus relieving all tension from within on the terminal portion of the wire which is left buried in the chest wall. The first time the writer used the undulated wire on a case of aneurism, the needle was found to be of too small a bore to allow the free passage of the undulated wire, which feeds in under much greater resistance than does the evenly-curved wire, so that finally with the clotting of the blood in the needle the wire jammed. After withdrawing the needle the piece of the wire left in the needle track tended to regain its undulated form, thus exerting pressure on the adjacent tissues, which caused necrosis along the track of the wire, and this in turn was followed by rupture through the skin and death of the patient from hemorrhage. The larger loops are generally shaped so as to have a diameter of about 5 inches, and the smaller loops, a diameter of about  $2\frac{1}{2}$  to 3 inches. Four cases of thoracic aneurism have been wired, using the undulated wire with the smaller loops interposed between the larger. Of one of these patients whose aneurism formed a small prominent tumor on the front of the chest, and in whom a No. 30 wire was used, it was reported three and a half months after the operation, that the tumor had receded so that the chest wall was flat. Another of these patients, who died with symptoms of cerebral embolus, had a broad clot adherent to the wall of the aneurism underlying the area through which the puncture

## THORACIC ANEURISM WIRED

with the needle was made, and in the clot considerable wire was embedded. In the third case hardening of the aneurism around the site of puncture ensued. The fourth case, who had a pulsating tumor which projected quite high from in front of the sternum, died from rupture four and a half months after the operation. At autopsy it was found that there was an extrathoracic expansion of the aneurism which communicated with the intrathoracic portion by a perforation through the sternum about  $1\frac{1}{4}$  inches in diameter, through which bony opening the wire had passed to become deposited within the intrathoracic portion, in the recesses of which organized deposit was found entangled in the peripherally located wire. Thus the extrathoracic portion of the aneurism got no protective clot formation within it, yet the external tumor primarily following the operation receded very much in size. In the two latter cases the current used was 100 ma. for 30 minutes.

The autopsy in the last case just cited, has shown that the current of 100 ma. electrifying the introduced wire for thirty minutes, caused a good deposit to be laid down in those localities in which it was possible for deposit to form, which had undergone organization. The writer also is inclined to believe from his experimental work, that, with the use of a current of 100 ma. for thirty minutes, less extraneous fibrin will be deposited during the electrical séance on the portion of wire in relation with the very rapidly flowing blood, than there would be with the sequence of 100 ma., 50 ma., 40 ma. and 30 ma. each for fifteen minutes, as heretofore used. The writer advocates making the wire grease-free, since in dogs a grease-free wire produces the more reliable clotting. The wire when first straightened out before being shaped, should have the grease from the shop removed from it by stripping it with gauze wet with alcohol. When the wire has been shaped and is coiled ready for use it should then be boiled in a 10 per cent. to 15 per cent. washing soda solution for further removal of grease, then rinsed in plain water to remove the soda, and finally boiled once or twice more in distilled water.

The writer has wired the aortas of 239 dogs in the surgical laboratory of the New York University and Bellevue Hospital Medical College, to which institution as well as to Dr. Richard M. Pearce, former Professor of Pathology, Dr. John W. Draper, Associate in Experimental Surgery, and Prof. Douglas Symmers personally, he is indebted for many courtesies in the course of this work.

## CHRONIC CYSTIC MASTITIS OR ABNORMAL INVOLUTION OF THE BREAST\*

By PARKER SYMS, M.D.

OF NEW YORK

THE condition I have chosen for my topic is a complex one. Of its etiology, we know very little or nothing. The histological changes are of such a variety that the disease has received a great many names, most of them indicative of some characteristics of the pathological changes; and these changes vary so much in different cases that an observer is very apt to give a name to the process depending on those changes which have appeared most prominent and conspicuous in the cases he has studied. For instance, it has been called interstitial mastitis because of the over-development of the interstitial fibrous tissue of the gland; it has been called cystic mastitis on account of the abundant cyst formation; it has been termed a form of adenoma on account of the abnormal development of the epithelial structures; it has been spoken of as an epithelial cirrhosis (Quenu), a chronic cystic mastitis (Koenig), cystic disease of the breast (Reclus), cyst-adenoma of the breast (Schimmelbusch), abnormal involution of the breast (Warren), senile parenchymatous hypertrophy (Bloodgood), fibroma mammæ tuberosum or lobulare and also interstitial mastitis (Virchow), and as chronic mammary tumor (Astley-Cooper).

Sometimes certain portions of the breast will be occupied by more or less distinctly defined masses or tumors; then a general chronic cystic mastitis may be overlooked and the diagnosis of adenofibroma may be made if the connective tissue predominates, or of fibroma-adenoma, if the epithelial or glandular structure predominates.<sup>1</sup> In its proper place, I feel that it will be well to go quite fully into a description of the pathohistological changes which take place.

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\* Read before the New York Surgical Society, October 25, 1916.

<sup>1</sup> The following incomplete list of titles which have been given to this condition illustrate the above statement. Noticeable is the case of Koenig, who was prompted by one series of cases to call it interstitial mastitis, and by another series of cases to call it chronic cystic mastitis. Chronic mammary tumor, Astley Cooper; cystic disease of breast, or intra-acinous cystic epithelioma, Reclus; epithelial cirrhosis, Quenu; interstitial mastitis, Koenig; chronic cystic mastitis, Koenig (1893); nodular mastitis, Phocas; *maladie noueuse*, Phocas; fibroma mammæ tuberosum or lobulare, Virchow; cystadenoma, Schimmelbusch; mammary cirrhosis, Wernher, Billroth; cystic epitheliomata, Lacoulet; papillary epitheliomata, Cornil; chronic mastitis, Lockwood and others; mastitis chronica

## CHRONIC CYSTIC MASTITIS

*Etiology.*—As I have said, we know very little, almost nothing, of the causation of the disease. We know that it occurs in women, usually after the thirtieth year; it occurs among women who have borne children, among married women who have not borne children, and among single women who have not borne children. It also occurs in men. In one male patient of mine, it developed in each breast, and each breast was removed (some years apart) on account of the evidences of rather rapid development. Owing to the fact that it usually takes place between the thirtieth year and the period of the menopause, and owing to certain of its pathological characteristics, it has very appropriately received the term of abnormal involution. Again, owing to the fact that it develops during the age period just cited, it represents a change taking place in the breast during the actual cancer period.

Owing to the remarkable changes which take place in the epithelium, and the fact that a large proportion of these cases become cancerous, it is proper that it be considered as one of the precancerous conditions.

Acute mastitis sometimes precedes the development of this chronic form, and it doubtless is an etiological factor in a small proportion of the cases.

There is little if any evidence to show that traumatism has acted as a causative factor in this condition. The breasts are constantly liable to slight traumatism and to irritation, and of course, the breast itself is essentially an inverted portion of the skin, and there is no doubt that some forms of irritation may be directly transmitted to it.

Being an inflammation, we must assume that the phenomena are really a series of responses to some form of irritation, either mechanical, bacterial, or chemical. The physiology and even the structure of the breast are strongly influenced by diseases of the female pelvic organs. There are some who claim that all such hyperplastic inflammations are caused by toxins produced in the stagnant bowel—in other words, that they are due to auto-intoxication, the result of fecal stasis.

To my mind, it is more likely that we shall find its explanation in the very unstable nature of the structures of the gland itself, and in the very unstable nature of the physiological functions of the gland. If one will bear in mind the fact that the mammary gland goes through many changes, in both its function and its actual structure, then one will see that it is easily possible for this change to extend beyond the

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fibrosa, L. Gelpke, C. Schlatterer; epithelial polycystoma, Sasse; fibrous and glandular hyperplasia with retention cysts, W. F. Whitney; senile parenchymatous hypertrophy, Bloodgood; abnormal involution of the breast, Warren; mastite de la menopause, chronic diffuse mastitis, Baumgartner and his French colleagues.



range of normality and to enter into the domain of disease. The mammary gland has a transient function and it *almost* has a transient existence. It is not fully established or developed until after the age of puberty. About that period of life, it undergoes a great metamorphosis. It is subject to similar changes at every menstrual period—though of course to a limited degree. During pregnancy a complete change takes place in the gland, and during lactation the gland assumes an entirely new proportion and of course takes on an entirely new function. Every structure of the gland is altered. After the function of lactation has ceased, the gland undergoes an involution, when the tissues are again being transformed and changed in a remarkable degree.

After the menopause, comes the period of involution and atrophy, the usefulness of the gland having ceased.

So, it will be seen that the mammary gland, throughout life, is subject to rapid evolutions and involutions, with constant changes in its actual tissue; so that the component structures of the gland are extremely varying in their relations one to the other, and extremely varying in their inherent composition and structure. For instance, a fully developed gland has structures which would be absolutely abnormal for the same gland before puberty, and a lactating gland has structural arrangements which would be absolutely abnormal during the quiescent period.

The epithelium is singularly unstable and subject to change in both its quantity and its quality, and in its relation to itself and to the other structures of the gland. Of course, anything that disturbs the equilibrium of these changes which take place within the range of normality may lead to an overproduction of any or of several of the structures in such a manner as to result in a condition of chronic cystic mastitis with more or less tumor formation. Rodman advances the theory that miscarriage and abortion may be responsible for the initiation of many of these cases. Abortion represents a sudden and unnatural interruption of functional and structural evolution.

There is a singular analogy between this condition and the condition commonly known as senile hypertrophy of the prostate. Senile hypertrophy of the prostate is really a chronic cystic prostatitis. The prostate gland is subject to great physiological excitation, and its structures take on much the same changes as do those of the breast, and when the so-called hypertrophy takes place we find very similar pathological changes in it, and the two conditions are similar in their liability to transformation into cancer.

## CHRONIC CYSTIC MASTITIS

*Pathology.*—As I have said before, each observer who has given a name to this condition has been actuated by the special changes in the structure which have been most prominent in the cases he has seen. Perhaps each of the names cited above is correct in so far as it suggests or defines at least one phase of the process. It will be seen that some authors have considered this to be purely an inflammatory process; others have considered it entirely hyperplasia; while still others have seen only the evidences of tumor formation.

Probably no one name in the entire list given above is sufficiently comprehensive, except the indefinite one of Warren, namely, abnormal involution of the breast. Whitney has probably come nearer to it than any one, and his title would have been correct had he amplified it thus—chronic mastitis, with fibrous and glandular hyperplasia with retention cysts. The disease is undoubtedly primarily an inflammation. The various pathological changes found represent either distinct stages of the disease, or its development according to certain tendencies. Thus, different cases of this one disease will represent a great variety of processes, and it is also true that we will find different parts of the same breast showing a variety of pathological changes, almost contradictory in their character. The inflammation affects the glandular structures, and it is manifested in the lobules and in the lobes of the gland. As it affects the glandular structures more than it does the ducts, it will be found most prominently in the periphery of the breast. It is characterized by proliferation of the glandular epithelium and of the fibrous tissue which comprises the stroma of the gland. One of its chief characteristics is the formation of cysts. These cysts vary in size from that of a millet seed to that of an orange. Various theories have been advanced as to the manner in which these cysts are produced. Some claim that they are purely retention cysts, that they are accounted for by the over-production of the fibrous tissue of the canals and ducts, with obliteration of their lumen, by stricture formation, and that they are simply retention cysts behind these strictures. Others claim that they are formed by the breaking down of fibrous septa between acini and ducts, with their consequent coalescence; thus two or several acini become one cyst cavity. Again, others claim that they are the natural result of actual epithelial hypertrophy and proliferation, with ultimate desquamation and degeneration of the cells. Normally the acini and canals are lined with a single layer of epithelium of the cuboidal type.

In this form of chronic mastitis, there is a very active change in the epithelium; there is a change not only in the character of the cells, but a great increase in their numbers, and several layers become super-

imposed one upon the other; they become arranged in cylindrical masses, clumps of them being detached so as to form actual fringes or papillary masses within the cavities. In many respects this is not very different from the changes which take place in the epithelium during the period of lactation. The hyperplasia which takes place in the fibrous tissue may be the predominating element, the walls of the acini, the ducts, canals, and canaliculi becoming thickened and fibrous. These over-productions may appear like tumor formations, but they do not progress to isolated and encapsulated tumors; they are more like tumorous masses. In these tumor-like masses, we find examples of so-called adenofibroma, or fibro-adenoma, depending upon whether there is a predominance of the fibrous tissue or of the glandular elements.

The phenomenon with which we have to concern ourselves mostly is the behavior of the glandular epithelium. It depends upon just how far these cells depart from the normal (in certain particulars)—whether or not transformation into a carcinoma has or has not taken place. Undoubtedly, the determining point is the fact that masses of epithelial cells have so infiltrated the surrounding structures that they have penetrated their basement membrane. This corresponds with Adami's definition, which is as follows:

We regard as cancer all cases in which there is infiltrative, and apparently independent, growth of epithelial or gland cells into the surrounding tissues, and this whether of only slightly atypical or markedly atypical cells.

Microscopic examination of specimens from a series of cases and of different parts of the same specimen will show that the epithelium can go through a very wide range of changes without evincing cancer, and will show the final steps in epithelial derangement which constitute the actual transformation into carcinoma. In this connection, we may find that there is a hypertrophy of the cells; we do find a hyperplasia, that is to say, an increase in the number of cells; then we find disorderly arrangement of the cells; we find the cells in a condition of potential or of actual growth, as evidenced by an increase in the size of their nuclei; we find atypical forms of cells; we find the cells displaced, so that there is an abnormal arrangement of the cells, in their relation to surrounding structures and in their relation one to the other; and, lastly, we find penetration of the cells through their basement membrane. There may be rupture or loss of basement membrane. This is cancer.

In different parts of the same breast, we will find these epithelial changes in different stages, and thirty or forty different sections may have to be examined before one will discover a spot where actual trans-

## CHRONIC CYSTIC MASTITIS

formation into carcinoma has taken place. The part which has become carcinomatous is a cancer; the parts which have not become carcinoma are potential cancers, or are in precancerous states.

In reviewing and summing up these processes, it will be seen that the disease is a very complex one. It consists of a chronic inflammation, of hyperplasia of certain of the structures, of the production of fibro-epithelial tumors—which are really more than hyperplasias—and, finally, of the production of cancer. There is no doubt that these various histological changes really represent progressive stages of the disease. In his admirable book on "Pathology," Adami expresses this very clearly as follows:

There are obviously individual differences in reactive and regenerative powers, and these differences, in other words, the tendency to excessive cell growth, is an all-important factor in determining whether a given insult to the tissues leads merely to an orderly regeneration or to tumor growth. But it is equally clear that simple irritative and regenerative hyperplasia, adenomatous growth, and carcinoma, are stages which can be manifested in succession by the same tissue; that the differences are those of degree and not of kind.

Fortunately each case does not go through this entire gamut, or obviously each case would ultimately become a cancer, but a sufficient proportion of cases do follow this course to make us properly consider this condition as one of the precancerous states. We must bear this in mind when we come to the question of treatment.

*Symptoms.*—The symptoms of this disease are about as follows: There is tenderness, sometimes pain, in the breast affected; the disease is frequently bilateral. It is characterized by more or less indistinct swelling of the breast, often amounting to distinct tumor-like masses. The lesions are found principally at the periphery of the breast. There is seldom great increase in the size of the organ. It is more a change in texture than a hypertrophy. It is most common after the thirtieth year, up to the time of the menopause. There is seldom evidence of an active inflammatory process, such as heat, redness, etc.

The disease is usually discovered by the woman noticing a swelling in some portion of her breast; perhaps her attention has been directed to it on account of a sense of uneasiness or of actual pain or tenderness. Retraction of the nipple is not a characteristic nor a part of this disease, neither is adhesion of the skin nor fixation of the gland to the deeper structures.

The progress of the disease is slow and chronic, but it is not steadily progressive. Sometimes there are intermissions. Koenig has called attention to the fact that new nodules develop at each menstrual

period. After the menopause, complete atrophy may take place, by the over-production and contraction of fibrous tissue—the mammary cirrhosis of Wernher.

During the earlier stages, more or less resolution may take place, but when there has been much hyperplasia, especially with the formation of tumor-like masses, restitution to the normal can hardly be conceived. The disease may reach a certain height and remain stationary, or it may undergo transformation into carcinoma.

We have shown how chronic mastitis may vary, not only in degree but also in character; how it may represent merely a chronic hyperplastic inflammation, or how it may become more than a hyperplasia, an actual benign tumor formation—fibro-adenoma or adenofibroma—and how it may produce a cystoma or cystadenoma, and also how the epithelial changes may progress beyond these innocuous forms into the generation of cancer. Have we any means of determining clinically just what pathological change is present or is taking place? In a way, we have not. We have no reliable statistics to show just what proportion of these cases become cancerous. Some authors who have gone into this question have not given statistics, but lay stress on the fact that cancer is likely to develop. Those authors who have given statistics have varied greatly. I quote a few as follows: Greenough and Hartwell place it at 10 per cent.; Warren at 13 per cent.; G. Verga found 5 cases of cystic mastitis with cancer among 28 cases of tumors in the breast; Lockwood, in 40 cases, found 8 cases of cancer, and 3 which he marked as suspicious, making more than 20 per cent.; Finney, quoting others, placed the proportion of cancer as from 10 to 50 per cent.

Some clinicians have been vague as to statistics, but emphasize the fact that we should be on the lookout for evidences of transformation into cancer, but they do not tell us what evidences we should look for, nor what are the signs of cancer development in these cases. Of course, it may be assumed that any new and unaccountable activity in a breast which has long been the seat of a chronic mastitis should be regarded with suspicion and treated accordingly. Some claim that we should always regard this condition as being a precancerous state, and that we should always treat it as such—that is to say, treat it as a potential cancer by unsparing ablation. Others claim that we sufficiently perform our duty to the patient if we remove apparent tumor formations, for instance, by means of the plastic operation of T. Gaillard Thomas. Some advise that we should remove these isolated tumors and subject the specimen at once to microscopic examination by the aid of a frozen section, and if the microscopist pronounces it to be cancerous that one

should immediately proceed with the radical operation for removal of the breast, pectoral muscles, lymphatics, and all.

As pointed out by Bloodgood, this is presenting itself to the surgeon as a new problem. Heretofore surgeons have been seeing breast tumors not early, but late, in a state of full development. The ever-increasing knowledge on the part of the general practitioners and the instruction that is being given to the public through the organized cancer campaign are bringing about a new state of affairs, and we surgeons are beginning to see these cases during their early periods when they are in a condition to which we have been more or less strangers in the past. Our statistics will have to be revised. Twenty cases of cancer in a hundred cases of chronic mastitis seen by the surgeon will perhaps be reduced to ten or to five in the next group he sees. Our perplexity will be greater, but our comprehension of the subject will be much increased.

On looking over the literature, and I have made an extensive research of it, I find that there is not that unanimity of opinion which we would expect. I feel that the proposed treatment, as outlined by many, is not a logical sequence of their own statements.

To my mind, we should regard this condition of chronic cystic mastitis as more than a possible cancer. We should regard it as a pre-cancerous condition, and each case should be considered as a potential cancer; we should perform a radical ablation of the breast. I believe that simple amputation of the breast is not so effective. The radical operation is all that its name implies, and it is no more mutilating, no more disfiguring, and no more dangerous than the lesser and less effective procedure.

If we pursue this plan, we shall certainly sacrifice some breasts that might have been preserved, and we shall sometimes perform a major operation that is not necessary, but it will result in the greatest ultimate conservation. In other words, we shall operate in some cases where cancer would not have developed, in some cases of unrecognized cancer already in existence, in some cases in which cancer is imminent and in which it would develop, but by treating all these cases in this manner we may have 100 per cent. of success as far as cancer is concerned.

On the other hand, if we watch these patients and endeavor to detect signs of cancer formation, we shall be making many mistakes, for we have no accurate knowledge of any clinical signs upon which we can rely. We do not know the symptom or symptoms which indicate that cancer transformation is taking place or has taken place. If we attempt to treat these cases by partial operation, I mean by the removal of one or more prominent tumor-like masses, we shall be making mistakes. In a

certain proportion of cases we shall be removing benign tumors and leaving malignant growths behind.

If we depend on removing a small portion of one of these glands and subjecting it to immediate microscopic examination by the frozen section, we shall be misled in at least a small proportion of cases.

Permit me to quote something pertinent which I recently published on this phase of the subject:

This is one condition where frozen sections should not be relied upon. If one were to depend upon a frozen section, made at the time of operation, to determine whether or not he should do a radical operation, he would necessarily make many mistakes. We must rely on the clinical evidences and on our general experience. In these cases the transition into a cancer may be evidenced in only one part of the gland, and it is a fact that a pathologist will frequently make twenty or more sections from different parts of such a breast before he happens to find one that demonstrates cancer. If that be so, the chance will be twenty to one against a correct diagnosis.

I recently reported such a case before the New York Surgical Society. This woman came to me with a typical chronic cystic mastitis, with a well developed fibro-adenoma in the upper and outer quadrant of the breast. Depending on clinical evidence alone, and guided by my own convictions in this matter, I performed a radical ablation of the breast after the method of Willy Meyer. The specimen was sent to our laboratory; several sections were made, and the pathologist reported the tumor to be a fibro-adenoma and that there was no evidence of cancer found in the breast. Some weeks later I wished to study the sections he had made, and fortunately they had been lost. I say fortunately, because new sections had to be made for our purpose, and one of these showed epithelial changes which the pathologist reported as being distinctly cancerous. Of course, this is not a rare occurrence, by any means, but it certainly shows how unreliable would be the examination of a small number of frozen sections made at the time of operation.

I must confess that this presents to me a very difficult problem each time I am confronted with it. It is often difficult to bring ourselves to apply a general rule to an individual case. When we see a patient who has apparently not progressed to the stage of cancer formation, we naturally hesitate to advise such a mutilating procedure as is the radical operation. We are very much tempted to the non-disfiguring procedure of removal of the prominent tumor mass by means of the plastic operation of Thomas, but if we yield to this temptation some cases will undoubtedly give cause for regret. Early radical operation will result successfully in 100 per cent. of cases. The waiting and watching policy, or treatment by the incomplete operation, will result in a certain percentage of failures.

The micro-photographs (Figs. 1-10) which I am using to illustrate the pathology of this condition, I think are of particular interest. The

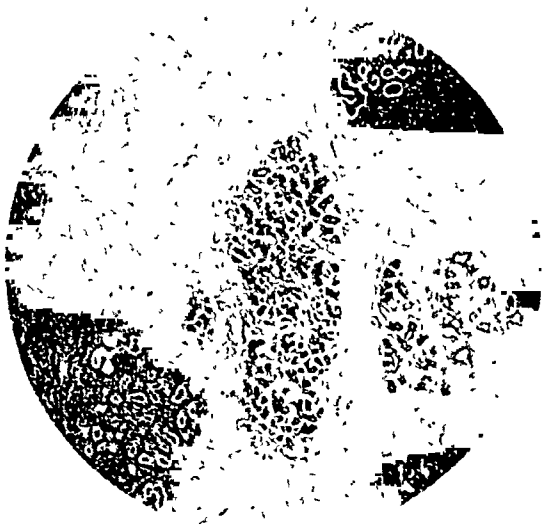


FIG. 1.—Normal adult breast, showing typical lobule with the normal proportion of fat cells, and with ducts of normal size. There is some increase of the fibrous stroma, no more than may be found in a normal adult breast.

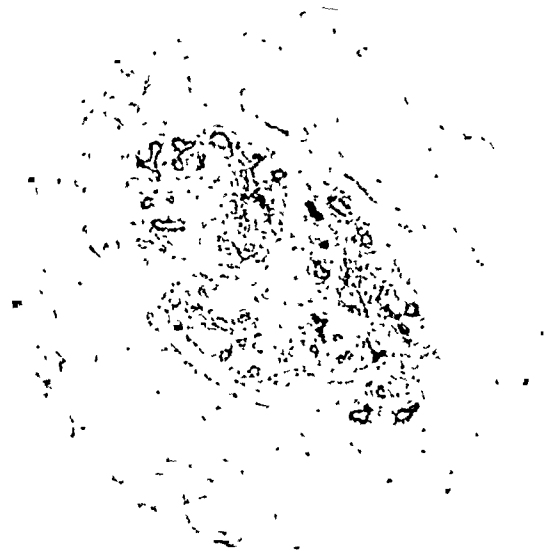


FIG. 2.—Section from same breast as Fig. 1, showing distinct fibrosis; abnormal involution. The glandular elements are compressed by the markedly increased acellular fibrous tissue.

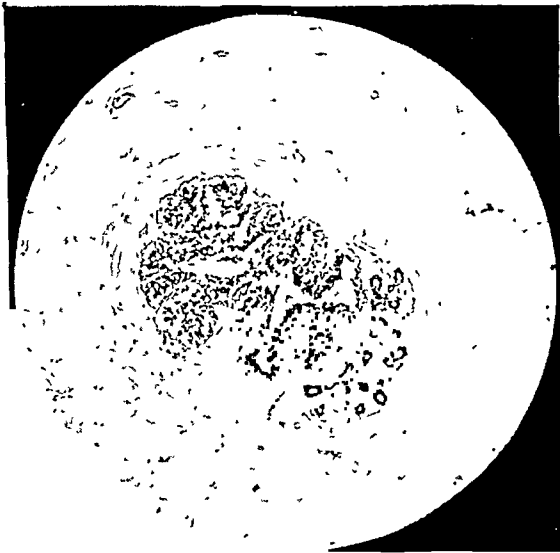


FIG. 3.—Section from same breast as Fig. 1, showing distinct fibrosis, a diminution of fat cells, a large duct showing atypical proliferation of the lining epithelium.

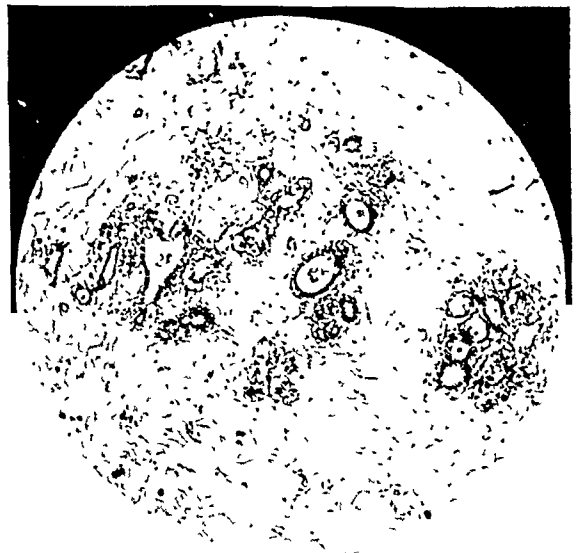


FIG. 4.—Section from same breast as Fig. 1, showing fibrosis, atypical proliferation of epithelium, early stages of cyst formation.



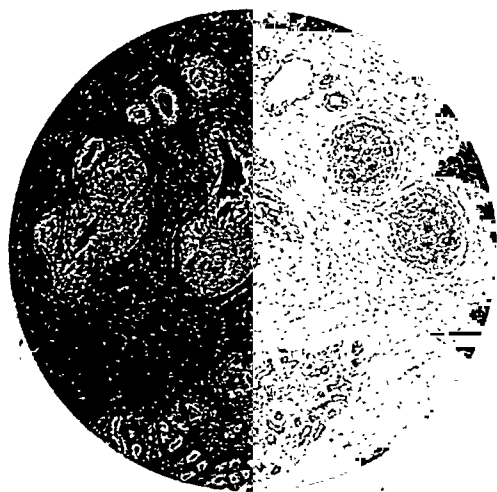


FIG. 5.—Section from same breast as Fig. 1. Precancerous condition, fibrosis, atypical proliferation of epithelium, producing definite epithelial plugs in dilated alveoli.

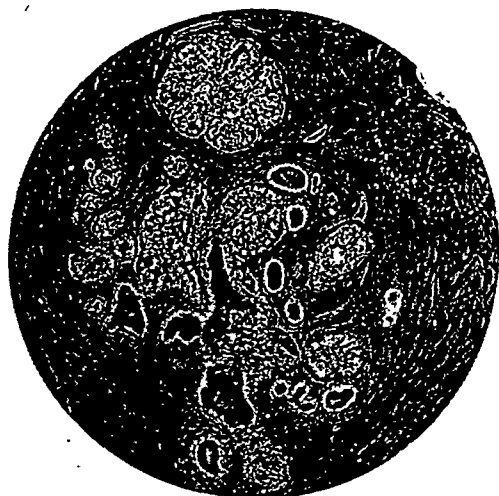


FIG. 6.—Section from same breast as Fig. 1. Precancerous condition, fibrosis, atypical proliferation of epithelium, epithelial plugs in dilated ducts and alveoli with papillary overgrowth of epithelium in ducts.



FIG. 7.—Section from same breast as Fig. 1, showing typical intracanalicular adenofibroma.

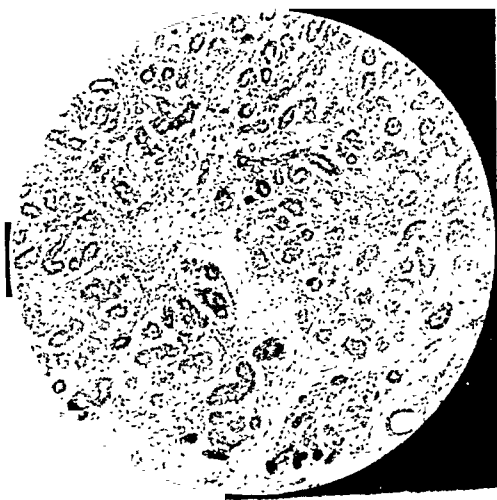


FIG. 8.—Section from second breast. Typical chronic mastitis showing round-cell infiltration and cellular stroma.

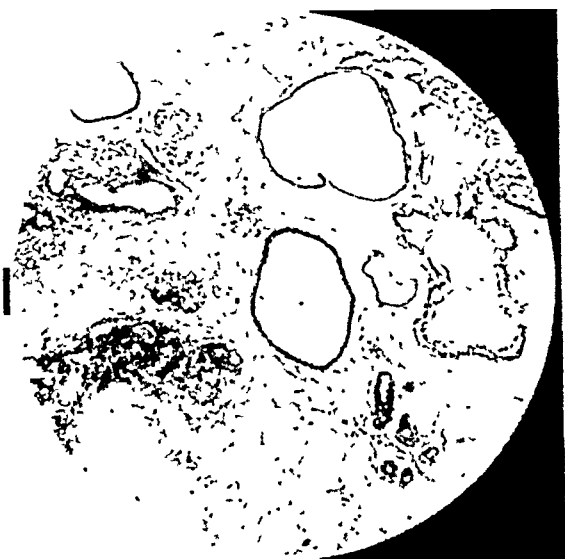


FIG. 9.—Section from same breast as Fig. 8, showing chronic mastitis with cyst formation.



FIG. 10.—Section from third breast, showing early small alveolar carcinoma of breast stroma infiltrated by tumor cells.



## CHRONIC CYSTIC MASTITIS

first seven pictures are made from sections taken from different portions of the same breast. They illustrate very beautifully the variety of processes spoken of in the text, and they bear out the theory that these various processes represent stages of development, or else development in accordance with certain tendencies as suggested by Adami. Sections taken from this one breast show the progressive character of the disease, so that we find one section showing normal breast tissue, another showing slight fibrosis (abnormal involution), another showing fibrosis plus atypical proliferation of the epithelium, others showing still further development characterized by cyst formation, others showing pre-cancerous changes characterized by a more marked overgrowth of epithelium, by hyperchromatism, and by disorderly arrangement of the epithelium. One section showed actual cancer as positively diagnosed by a competent pathologist. Unfortunately I have lost this slide.

These first seven pictures were taken from a breast which has been the cause of considerable disagreement—one pathologist pronouncing the breast to be entirely free from evidences of malignancy, the same pathologist as a result of another examination pronounced it to be the seat of fully developed cancer, another pathologist found in it the evidence of chronic cystic mastitis only, with no evidence of pre-cancerous changes, and another pathologist found definite evidence of precancerous changes.

To my mind these sections show positively how unwise it would be to rely upon an examination made by means of frozen sections. On this breast alone I would rest my case in the very positive attitude I take on this question.

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# REGRESSIVE CHANGES IN THE BREAST

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IN the period covered from June, 1915, to August, 1916, we have records and specimens of 76 operations performed for tumors and lesions of the breast by operating surgeons connected with the New York Post-Graduate Hospital.

The clinical data obtained from the recorded case histories and examinations in these breast lesions have been carefully studied in connection with the pathological specimens received in the surgical laboratory.

The histopathological studies and findings have been made by Professors MacNeal and Taylor in the pathological laboratory.

An analysis of the 76 cases in which diagnoses were made and proven shows rather strikingly the fact that during the last 14 months (when our studies first began) the percentage of frankly malignant lesions of the breast receiving surgical treatment has been greatly reduced, and that during the same period a corresponding increase in the percentage of benign conditions that have been treated by less radical surgical measures has been recorded.

In the series of 76 observed cases covering June, 1915, to August, 1916, 38 lesions, 50 per cent. were found (from an associated study of the clinical, gross pathologic and microscopic pictures) to be definitely benign.

What is meant by definitely benign here is that in no cases were known malignant changes present.

A separate grouping for the so-called precancerous, or potentially cancerous, conditions has not been made, all of the lesions are reported as either malignant or benign.

Thirty-eight or fifty per cent. of the breast tumors were found to be frankly malignant, a reduction of about 30 per cent. from text-book statistics.

This reduction in the percentage of malignant tumors receiving surgical aid is not so low as recently reported by Bloodgood from the Johns Hopkins Hospital. In that institution during 1913 to 1915 the percentage of increase of benign lesions had risen to 59 per cent., thus reducing the malignant to 41 per cent. Bloodgood regards scirrhus,

medullary and cancer cyst types of carcinoma as the terminal or fully developed forms of cancer of the breast, and the adenocarcinomata as earlier and less mature forms. His most recent figures (statistics since 1913) show percentages of fully developed cancer in relation to the other forms of breast carcinoma as 78 per cent. Our percentages covering the same type lesions during 1915-1916 are 72 per cent.

The 38 benign and 38 malignant breast lesions (total 76) are grouped under their respective headings as follows:

*Malignant:*

Scirrhus carcinoma .....	16 cases
Adenocarcinoma .....	9 cases
Medullary carcinoma .....	7 cases
Adenocarcinoma, cystic .....	2 cases
Carcinoma, recurrent .....	3 cases
Sarcoma .....	1 case

*Benign:*

Chronic cystic mastitis .....	18 cases
Intralobular fibromyxoma, intra- and pericanalicular..	5 cases
Papillary cystadenoma (non-encapsulated) .....	5 cases
Mastitis (following lactation) .....	5 cases
Tuberculosis .....	1 case
Gumma .....	1 case

It should be noted that chronic cystic mastitis comprises over 47 per cent. of the benign group of breast lesions, adding to this the 5 cases of non-encapsulated papillary cyst adenomata which the writer believes properly belong to this group the percentage reaches 60.5 per cent.

The most frequently seen benign connective-tissue tumor, the intra-lobular fibromyxoma, peri- and intracanalicular forms, makes up 26 per cent. of our benign tumors. The remaining 13½ per cent. comprises the following:

	Per Cent.
Lactation mastitis .....	8
Tuberculosis .....	2¾
Gumma .....	2¾

The small encapsulated, smooth, firm, and hard adenofibroma has not been observed in this series.

While perhaps positive conclusions are not justified from the small number of cases here presented, the figures are at least suggestive and significant, and strongly point to a much keener conception on the part of the profession and the laity of the dangers of delay in seeking surgical relief. Competent advice is being sought earlier, malignancy is on the decline in breast lesions, and fewer radical operations are the result.

As it is manifestly impossible to cover in one paper the results

## REGRESSIVE CHANGES IN THE BREAST

of our studies of the different types of breast tumors observed, our further remarks will be confined to a consideration of those so-called precancerous, potentially cancerous, or borderline conditions of the breast that have been included here in the division of benign tumors. They form over 60 per cent. of our non-malignant cases.

It is of course recognized that each one of these lesions in the living subject possessed the potentialities for malignancy which make of them a most interesting group for surgical study.

But as Ewing states, "it should be emphasized that these diseases possess in themselves not a single essential element of the cancerous process."

MacCarty, in a recent careful study of 398 cases of carcinoma of the breast, found in every instance a coexisting mastitis. He agrees that the chronic mastitides do not necessarily mean eventual cancer, but contends that in every case of cancer will be found a chronic mastitis.

Billroth was the first to observe that cancer seemed never to arise in a normal breast.

For lack of a better term 18 of these regressive breast lesions have been classified as chronic cystic mastitis, the most commonly accepted term now used for this retrograde process, which embraces a macroscopic picture of fibrous and glandular hyper- or cytoplasia without encapsulation. Within the mass or masses are single or multiple cysts.

In a clinical sense the title of chronic cystic mastitis is somewhat a misnomer because clinical evidences of inflammation are absent, and histologically round-cell infiltration, dilated and distorted acini and ducts and fibrous and epithelial cytoplasia may readily be found in the opinion of the writer in any involuting breast. A proof that the term is not altogether exact or satisfactory is found in the many designations the lesion bears, such as fibrous or glandular hyperplasia with retention cysts (Whitney), abnormal involution (Warren), senile parenchymatous hypertrophy (Bloodgood), Schimmelbush's disease, Reclus disease and numerous other terms, none of which give a clear definition or understanding of the abnormal process or processes.

Different stages of this diseased condition of the breast give varying clinical gross pathologic and microscopic pictures which probably account for the numerous names given these interesting lesions. Two of the 18 cases of chronic cystic mastitis operated upon in this group were found in male breasts.

A general summary of our findings follows:

The ages of patients at time of operation ranged from twenty-one to sixty-eight years.



The ages of patients at first symptom of onset of disease varied from eleven years of age to sixty years.

The duration of the disease varied from one month to eleven years.

In 66 per cent. the symptom of onset was the finding of an irregular shaped mass or masses in the involved breast. In 30 per cent. pain and tenderness was the first symptom noted. In one case only was a discharge from the nipple seen. In one case a definite retraction of the nipple was observed.

In every case examined the skin was apparently normal. In no instance was absence or atrophy of subcutaneous fat noted. In two cases enlarged axillary glands were demonstrable.

Our investigations indicate that the lesions usually arise in and around the so-called nipple zone (15 cases). In two cases the mass was confined to the upper and outer quadrant and in one case the inner and lower.

Irregular masses single and multiple ranging in size from that of a pea to a hen's egg have been revealed upon palpation in 14 cases. The consistency of the lesions varied from moderately firm to hard nodular masses. In four cases no distinct tumors could be felt. Nine of the lesions occurred in the right and nine in the left breast.

In all cases the breast as a whole presented a degree of firmness not observed in the normal gland. Clinically no evidence of fixation or infiltration of structure was demonstrable in 16 of the 18 cases. As previously stated, in one case retraction of the nipple was noted. Seventeen of the cases operated upon exhibited abnormal increase of both fibrous and parenchymatous structure. In seven cases a marked diffuse fibrosis was the prominent pathologic picture. In two cases a greatly increased parenchymatous hyperplasia existed. In one breast (male) the glandular elements were negligible, a practically fibrous (non-encapsulated) mass forming the lesion. In eight of the cases macroscopic cysts, single and multiple, were present. On section the cysts were seen to vary in size from a bird shot to a pigeon's egg. The cystic contents generally were fluid, albuminous, turbid, or clear, straw-grayish and brownish in color.

In practically all the lesions microscopic fields revealed numerous areas showing dilatation and distortion of the ducts and acini cytoplasmia and round-cell infiltration.

*Operations.*—In 14 cases the entire gland has been removed. In none of these cases was there noted any abnormal condition of skin, or nipple, subcutaneous fat, infiltration or fixation in any direction, or axillary gland involvement.

In 2 cases the gross pathologic appearing areas only have been

removed, and in 2 cases so-called complete operations (including removal of axillary glands and fat and pectoral muscles) were performed, because of the suspicion clinically of malignancy.

In one instance there was apparent enlargement on palpation of axillary glands, and in the other definite retraction of the nipple and enlarged axillary glands.

In all of the lesions the microscopic pictures were negative for invasive or migratory cytoplasia.

The question arises, is it possible by our present methods of examination of this type lesion, to determine definitely and positively that no microscopic area or areas of adenocarcinoma are present or exist, when no gross picture of even suspicious tissue can be identified, or when dozens of frozen or imbedded sections prove negative upon microscopic study.

It is the opinion of the writer that microscopic areas giving the picture of malignancy probably exist without detection in many of these lesions, even when most painstaking study and search have given negative findings. If such is the case, how great a value may be placed on a negative microscopic finding?

The other phase of the question is how much value should be placed upon the microscopic picture alone, of a small isolated area of apparent adenocarcinomatous change, when the microscopically malignant mass is situated well within the boundaries of the mammary gland (even though it shows active cellular mitosis) and gives no clinical or gross pathologic evidence of its presence.

The writer is firmly of the opinion that the proper interpretation of the clinical operative and gross pathologic pictures these lesions present must be the guides and factors that decide the type of operation necessary to be performed in any given case. The microscopic discovery of a localized area only (without macroscopic appearance of any degenerative process) should not be the factor in deciding upon a so-called radical or complete breast operation for cancer.

The non-infiltrated, encapsulated, freely movable tumor, in the mammary gland, where skin, fat, capsule axillary glands, nipple, etc., are not infiltrated, requires only surgical removal of the tumor with its capsule. In chronic cystic mastitis the real boundary zone of the lesion is the gland itself, until such time as the regressive changes that here occur are established, or disposed of, as being precancerous in their nature, the operation for the removal of the entire gland, with nipple and areolar tissue, should be advocated.

On the other hand, it does not seem justifiable to perform the so-called radical or complete breast operation in the absence of definite clinical or gross pathologic signs of infiltration or degeneration even

where the microscopic field shows a localized area of epithelioma cellular invasion or migration into the stroma, so long as the malignant microscopic area is well within the boundary zone of the gland.

Accepting Sampson Handley's theory that carcinoma spreads by permeation (and until the larger lymphatic trunks are reached this seems to be true), ablation of the breast alone would seem to be sufficiently radical where our clinical operative and gross pathologic criteria, after careful study, fail to exhibit any factors we regard as cancerous. In other words, the discovery of a microscopic area of cancer should not be the signal demanding the most radical operation on the breast.

The 5 cases grouped under the designation papillary cystadenoma give clinical pictures resembling those of chronic cystic mastitis. They comprise non-encapsulated masses which exhibit in the gross and microscopic pictures cysts with intracystic papillomatous ingrowths imbedded in areas of more or less diffuse fibrosis, glandular hyperplasia and round-cell infiltration.

These lesions apparently belong to a mature and perhaps active stage of chronic cystic mastitis. One of the patients in this group exhibited masses in both breasts, the clinical picture being as follows:

Patient forty-five years of age; duration of tumors in both breasts one month; no increase in size of tumors since first observed. Symptom of onset in left breast, pain, prickling and dragging; symptom of onset in right breast, discovery of tumor. No discharge from nipples. Youngest child fifteen years old. No lactation mastitis, menstruation normal. Both breasts moderate in size; skin, subcutaneous fat and nipples normal. No axillary glandular involvement. Small, firm, freely movable nodule size of a marble felt in right breast just below nipple. In left breast is felt a rounded, freely movable mass in the nipple zone, the size of an English walnut.

The gross pathology in the larger mass in this case gave a picture of numerous cysts of varying size containing clear fluid, the cysts being imbedded in a firm fibrous stroma. The papillomatous ingrowths were observed in the microscopic fields only.

In only one of the five cases was there definite large macroscopic papillomata within the cyst walls. The other three lesions presented nothing worthy of further report.

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# SPONDYLITIS DEFORMANS RELIEVED BY ALBEE OPERATION

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OF all the ills that man is heir to, none can claim priority over spondylitis deformans as a deforming and disabling disease, not only because of its chronic progressive nature, but also because of our inability either to check its progress or to relieve its distressing symptoms. A fully developed case once seen is not soon forgotten. It presents a most hideous spectacle. If one can conceive of a spine in which there has been a deposit of bone along the bodies of the vertebræ causing lipping of the margins, absorption of the intervertebral discs, marked kyphosis and ankylosis, and, as is frequently the case, pressure on the nerve-roots due to deposits around the intervertebral foramina, and if other joints are similarly affected, he will surely admit the accuracy of the introductory statement.

The appearance of these patients is quite characteristic. On standing, they present marked kyphosis of the spine which is as rigid and unyielding as a board, resulting in forward slope of the neck with the face looking downward. On attempting to look up, the pelvis is tilted backward and the knees flexed. On walking, they seem on the verge of toppling forward with each step. On lying supine, only a portion of the spine is in contact with the couch, the head, neck and shoulders being unsupported. On assuming a prone position, only the head and knees are in contact with the couch, the spine and thighs forming an arch. Fortunately, not all cases attain such a degree of severity.

AUTHOR'S CASE.—W. A., male, aged forty-four years, residing in Brooklyn, New York; occupation, plumber. He had never been previously ill with the exception of measles at the age of nine years, from which he recovered without complications. Twenty-eight years ago, while carrying a heavy weight (metal pipe), his back suddenly gave way, and doubled up like a jack-knife. For the following week, he was troubled with pains and stiffness of the back, but continued working. In the course of several years, noticed a protrusion of the spine in the dorsal region, round shoulders developed and some pain was always present but not sufficient to interfere with his work. It was in 1909, or twenty-two years after the above injury, that working became a hardship and from time to time he had to lay off.

In 1910, he came to the Dispensary of the Hospital for Deformities and Joint Diseases<sup>1</sup> for treatment. Examination showed that he was round-shouldered, his back kyphotic over the mid-dorsal region, stiff and painful on attempting any motion; scapula winged, chest emphysematous; his neck was bent forward, face looking downward, and he walked with a slow and careful gait, leaning forward slightly. In the lumbar region, movements were normal, but his upper back was rigid and tender. The X-ray showed an absorption of the mid-dorsal fibrocartilages with the vertebræ wedged. There was an outgrowth of bone with lipping of the margins of the sixth to ninth dorsal vertebræ on both sides of the median line. Blood, urine and sputum were negative. Temperature was normal.

A plaster jacket was applied to be worn continuously. Tonics were prescribed. Although the pains were somewhat relieved, the patient was very uncomfortable in his jacket, was unable to work, and breathing, being abdominal, was interfered with.

In 1915, he reported at the hospital in a very depressed state of mind, because the disease was progressing; the jacket no longer gave any relief, and he was on the verge of pauperism owing to inability to work at his trade. He urged that something radical be done. An Albee operation was advised, but very little encouragement given as to the ultimate benefit to be derived, excepting that it might support the spine without the aid of a brace or jacket and would permit abdominal breathing.

On April 8, 1915, the operation was performed in the usual manner. A groove was made in the spinous processes from the fifth to the tenth dorsal vertebræ, and a graft from the tibia inserted. With the exception of a slight temperature lasting three days, he made an uneventful recovery. A jacket was applied on May 6; on May 10, the patient was allowed up, and on June 15, was discharged from the hospital.

During August, 1915, he discarded the plaster jacket and began to work in an ammunition factory. I have seen him once every three months since. He is absolutely free from pain, and there is very little restriction of motion in spite of the fact that his work is very laborious, consisting of carrying shells weighing up to 50 pounds. He has not lost a day during the past year.

So favorable a result was entirely unexpected. I had anticipated some benefit from the operation, but not complete relief. The only explanation I can offer is that as a result of inserting a graft into the spine, sufficient bony ankylosis occurred to give support to the spine and permit complete physiological rest to the diseased area; nature

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<sup>1</sup> From the Service of Dr. Henry W. Frauenthal.

under such favorable circumstances completing the cure. This was also a favorable case because the diseased area was limited to several vertebræ.

This is the first time to my knowledge that the Albee operation was attempted for spondylitis deformans, and in view of the result obtained, I believe it has a distinct indication in (1) those cases where the disease is localized, (2) in the early stages before the disease has progressed, (3) where there is an acute exacerbation on a chronic process, (4) where there is abdominal breathing which is interfered with by spinal brace or plaster cast, (5) as a last resort in those hopeless cases where all other methods have been tried and found wanting.

## FELONS

By GEORGE M. DORRANCE, M.D.

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It is a curious fact that in every walk of life the majority of us strive to do the big things with the result that some of the simpler, obvious, everyday things are treated lightly or totally ignored. Surgery is no exception to the rule. The youngest member of the profession seeks to invent some new methods of devising or improving major operations, thus neglecting the common ills with which he daily comes in contact. In every surgical dispensary and in the offices of many practitioners scarcely a week goes by that a patient suffering from a felon does not apply for treatment. In the vast majority of cases, he is told that the condition is not serious; some poultice or local application is made at the first visit and later, when suppuration occurs, it is lanced. This form of treatment often results in the loss of a part or all of the distal phalanx.

In the *Journal of the American Medical Association* for May, 1913, I published an article on the "Anatomy, Pathology and Treatment of Felons." This was the result of several months labor in the dissecting room, pathological laboratory and surgical dispensaries. At that time I gave the following definition, "A felon is the primary inflammation of the connective-tissue space which is situated on the palmar surface of the last phalanx of the fingers." This definition was determined only after a careful study of the anatomy of the finger and careful dissections of several felons. Wax was injected into the fingers, and frozen sections were made which clearly demonstrated the presence of this connective-tissue space.

Kanavel in his admirable work on infections of the hand did considerable work on the anatomy of the finger and, following out his plan, we had several sections made of the different parts of the finger. A study of these will show this space clearly and a knowledge of this will explain to a large extent the pathology of felons and suggest a logical treatment.

We also made some X-ray studies of the finger after injecting red lead into this connective tissue. Kanavel had already pointed out that the epiphysis of the distal phalanx was supplied by a branch of the digital artery before it enters this connective-tissue space. This I found to be true in most of my dissections. The diaphysis, however, not only

## FELONS

receives its blood supply from a different branch, but it is supplied only after the artery has passed into this connective-tissue space.

Now when we have inflammatory processes going on in this space with the subsequent swelling, the venous return is shut off, hence that peculiar throbbing pain so characteristic of felons, due, of course, to the pressure on the nerves with each pulsation of the artery; the pressure continuing, the arteries are compressed, thus shutting off the blood supply and necrosis ensues. The source of the infection is invariably a puncture wound, needle or pin prick, hence felons are more common in women.

*Symptoms.*—As a rule the first intimation the patient has of the trouble is a consciousness of a sticking pain in the tip of the finger, often describing it as if he felt a foreign body in there, *e.g.*, a splinter. Within a few hours, this gives way to the throbbing pain. Then the distal portion of the finger becomes red, swollen and tender. At the end of about twenty-four to thirty-six hours, fluctuation is present and all pain ceases. This symptom of relief is often misleading to both the patient and the physician, for instead of being a favorable condition, as they suppose, it means that gangrene and possibly necrosis are beginning.

*Treatment.*—An incision starting at the base of the nail on one side is extended in the line of the furrow over the tip of the finger, down on the other side to a point on a level with the beginning of the incision, in that way, making a flap of the tip of the finger.

The appearance after the flap is made and for the first forty-eight hours is often the source of worry to the patient and the operator. This is the critical stage in the treatment and on no account should the drainage be removed and the flaps returned to their original position. The final result will not be a deformity and bear this in mind. We grant that for a week or ten days afterwards you might regret your radical procedure, but experience has shown that if the method given above is carefully adhered to, the final scar will be scarcely noticeable.

The wound is dressed with normal saline solution. The dressings are removed daily, but the drainage is undisturbed until the third day, when it is permanently removed.

Keeping the parts moist by soaking the finger (dressing left intact) every third hour in normal saline solution is a source of comfort to the patient and aids drainage.

It is now practically three years since I advocated this method and have had the privilege of seeing many cases so treated by myself and others. The most common mistake made is not getting the incision close enough to the nail. This is absolutely essential to preserve sensa-



tion in the tip of the finger. Next in order comes the poor result from waiting too long. To be successful, it must be done early. Another bad incision is the longitudinal, which fails to give proper drainage.

I have 47 cases on file since my last paper, followed from beginning to end. Of these, 40 cases were opened within the first forty-eight hours, and complete cure ensued. Of the other 7, 5 were done after fifty hours had elapsed. Of the first two series the results were better than I have seen from longitudinal incision, and of the last two cases, one had to have the phalanx removed while the other recovered only after a long and tedious treatment with a deformed finger.

It can be dogmatically asserted that if the procedure is followed out properly, observing the rules, loss of sensation in the tip of the finger never occurs and the final result will be practically a normal finger.

#### CONCLUSIONS AND RULES

1. All cases are caused by puncture wounds.
2. Cases must be treated within forty-eight hours to get a perfect result.
3. Cases of over seventy-two hours' standing have usually damaged the bone.
4. Nitrous oxide anæsthesia is advisable in the majority of cases.
5. The length of time required for perfect function depends upon the time elapsing before treatment is instituted.
6. Restoration of function is quicker by this method than any other tried in my experience.

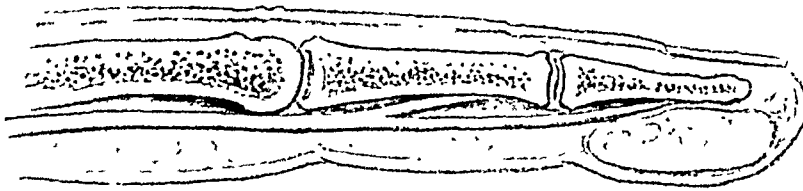


FIG. 1 —Note the fact that this distended space is walled off from the remaining subcutaneous tissue of the rest of the finger



FIG. 2.—Longitudinal section of distal phalanx of index finger. The bone was carefully dissected out before fixation so that decalcification was unnecessary. A, epiderm; B, dense fibrous corium; C, loose areolar fatty and connective-tissue space in its entirety, condensed fibrous tissue limiting the space at E, tendon of flexor longus digitorum



FIG. 3—Low power of the area B of Fig. 2. A, epiderm; B, dense corium; C, loose space; D, limiting fibrous portion of space; E, tendon of flexor longus digitorum.

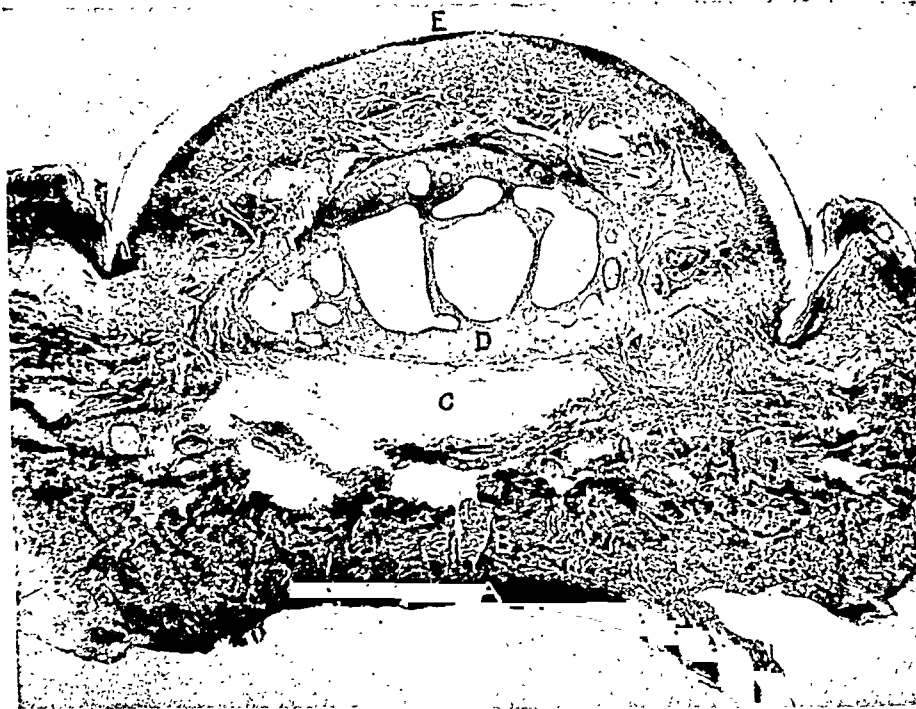


FIG. 4.—Transverse section of the digital phalanx. Section made after decalcification. A, epiderm; B, dense corium; C, loose areolar fatty and connective-tissue space, some of which is lost in section; D, bone; E, nail-bed.



FIG. 5.—Connective-tissue space injected with red lead.

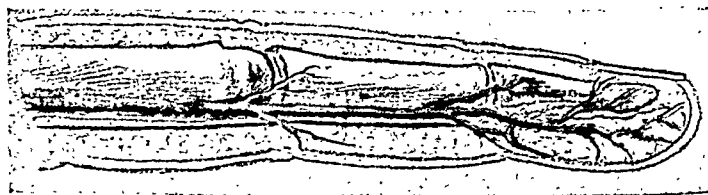


FIG. 6.—Note the fact that the diaphysis receives its blood supply only after the artery has passed through this connective-tissue space. In order to bring this point out more clearly we injected a mixture of red lead and turpentine into the radial and ulnar arteries of a cadaver and had X-ray pictures made.



FIG. 7.—Blood-vessels. Note how clearly this point is brought out in the X-ray plate



FIG. 8.—Proper incision.



FIG. 9.—Flaps with drainage



FIG. 10.—Note position of wrong incision which injures nerve supply to flap.



FIG. 11.—Nerve supply of finger.

# TRANSACTIONS

OF THE

## NEW YORK SURGICAL SOCIETY

*Stated Meeting, held October 11, 1916*

The President, DR. CHAS. N. DOWD, in the Chair

### TOTAL EXTIRPATION OF PENIS FOR CARCINOMA

DR. HERMANN FISCHER presented a man, sixty-three years of age, who was admitted to the German Hospital with nodular hard tumor, involving the glans penis. It was the size of a peach and had grown into the prepuce, so that the latter could not be retracted. There was quite a profuse discharge of ill-smelling pus from the preputial sac. In both inguinal regions there were large metastatic tumors, the glandular mass on the left side being as large as a man's fist and seemingly tightly attached to the sheath of femoral vessels.

As the man was very anæmic and not a very good surgical risk, the metastatic glandular tumors were first removed, and two weeks later the total extirpation of the penis was done. The incision circled around the root of the penis and divided the scrotum in the median raphe down to the perineum. The penis was then dissected from its attachments, including the crura; the pendulous portion of the urethra was removed in its entirety, being divided close behind the bulb, on account of metastatic carcinomatous nodules that had developed in the posterior portions of the corpora cavernosa penis and had encroached upon the posterior part of the pendulous portion of the urethra. After division of the urethra, its membranous portion was sutured to the skin in the perineum. The man made a good recovery. His bladder function is normal. The operation was done six weeks ago. This case was here shown because it is rarely necessary to sacrifice the whole pendulous portion of the urethra. The chances of getting a necrosis of the thin membranous portion with subsequent development of a stricture are therefore greater. In fact this undesired accident happened in an identical case, upon which he operated two years ago. The patient has to bougie himself once a week to keep the urethral opening patent.

DR. WILLY MEYER said that in such cases the decision is to be made whether to amputate the penis or simply extirpate the growth. He

preferred amputation after Bardenheuer's method in which is left a stump of the urethra with its corpus cavernosum right in front of the scrotum, projecting beyond the amputation line, for about one-half inch. This portion of the stump of the urethra unfolds itself, so to speak, and projects like a prolapse. There remains a wide opening of the urethra through which the patient urinates straight forward.

If there is further involvement, he would always divide the scrotum and extirpate the penis totally, which is not a difficult operation.

The point is to leave the corpora cavernosa as much as possible; the stump is then transplanted into the perineum in front of the anus. And there it is better to split the urethra posteriorly, making a slight hypospadias. Regarding the extirpation itself, it is best to primarily ligate the two dorsal arteries, with their veins, and to ligate also the two profundæ; then amputate the corpora cavernosa as near to the pelvic bone as possible, but always putting a retention suture through the septum first. In one case where he omitted that, the remnants of the corpora slipped back, and he had a good deal of trouble in pulling them sufficiently forward again to stop the hemorrhage. But if this is done and they are secured properly, one can in almost every case stitch the tunica albuginea of the one side to that of the opposite side, and in this way get primary union.

The principal point, however, is the involvement of the inguinal glands. In the majority of cases where recurrence occurs, it will rarely be found in the portions of the corpora cavernosa left behind, but in the inguinal glands. So the question, how far they are involved, will principally determine the final result.

#### PROSTATIC TUBERCULOSIS: ASCENDING RENAL TUBERCULOSIS

DR. EDWIN BEER presented a male, seventeen years old, who since four months has had pain at the end of the penis, marked frequency, and has passed clots. The blood was never mixed with the urine; it was either at the beginning of the stream or terminal. About two months before admission he had had pain in right lumbar region, and two weeks before admission similar pains in left lumbar region. Of late, just prior to admission frequency was half hourly. Examination showed slight right lumbar tenderness, kidney not palpable. By rectum prostate was small, the left lobe was atrophic, while the right lobe was practically normal. The urine contained many pus and red cells, a few tubercle bacilli, and was turbid. After gentle massage of the evidently tuberculous prostate, the urine was loaded with expressed tubercle bacilli.

## PROSTATIC TUBERCULOSIS

April 15, 1916: Cystoscopy showed a moderately inflamed bladder. The right ureteral meatus was wide open and admitted a catheter into the right pelvis. By introducing into the bladder some coloring matter, it was possible to recover same from the right pelvis, demonstrating that catheterized right kidney specimens were contaminated from the bladder and that such specimens would be of no conclusive value in determining whether the right kidney was tuberculous or not. On the left side no catheter could be introduced. Indigo carmine excretion from both sides was in diminished concentration but about equal. These findings were confirmed by re-examination. As it was impossible to decide by cystoscopy and ureter catheterization whether one or both kidneys were also involved in addition to the prostate, and as the wide-open right ureter might have been the result of back pressure from the very irritable bladder, as well as from a ureteral tuberculosis, it was thought that it might be possible to reach a conclusion by filling the bladder and taking pyelograms with argyrol in the Trendelenburg position. Much to our surprise the argyrol ascended both ureters, the left which could not be catheterized as well as the patulous right one. The right pelvis appeared deformed and its calices were dilated. The fact that both ureters allowed the ascent was very suggestive of the fact that we were dealing with a symmetrical process due to back pressure.

Old tuberculin injections were then resorted to to assist in clearing up the situation. Graduated doses were used up to 4 mgms. after determining the patient's susceptibility to the Pirquet skin reaction, which was positive. Under this the frequency became more marked, and the left atrophic half of the prostate became very tender. The temperature rose to 101, pain developed in the right lumbar region and this region became tender on palpation. After the last injection of 4 mgms. slight pains developed in the left lumbar region also. As these results were not conclusive, because they proved only that the left half of the prostate was tuberculous and did not definitely decide whether one or both kidneys were involved, the local pains and tenderness being possibly due to back pressure caused by the tuberculin irritation at the neck of the bladder and the associated increased frequency, which now was every fifteen to twenty minutes, it was decided to explore both kidneys and ureters, and to remove that side which was involved, provided the other was normal, and leave the prostate to take care of itself under hygienic measures.

May 13, 1916: The left kidney and ureter were exposed. The kidney was found to be normal and the ureter was found to be slightly dilated but of normal consistency and in no wise inflamed. This wound



was then closed. Then the right kidney was exposed. This was found to be enlarged and distended, and its ureter was markedly thickened as in the typical tuberculosis cases. A complete uretero-nephrectomy was then performed, by tying the vascular pedicle and freeing the ureter still attached to the kidney as far down as the lumbar wound permitted. After tying a traction ligature on this ureter at its lowest freed level, the kidney was replaced, and a second pelvic pararectus incision was made, exposing the pelvic ureter which was easily identified by traction upon the above traction ligature. The ureter was then cut off with cautery close to the bladder after ligation of the vesical end. Then by means of the traction ligature the whole ureter and its kidney were extracted from the lumbar wound without any contamination of the wounds. The wounds were closed in the usual way and the patient made an uneventful recovery.

The specimen presented showed a most beautiful ascending tuberculous process, with most involvement at the lower end getting less and less as the kidney was reached.

The patient who was not much more than skin and bones at the time of the operation, improved surprisingly in health and gained much weight. The frequency became much less, and the patient was discharged with both wounds closed, no infection of the wounds having taken place. His prostate was treated for a time with deep X-ray therapy. In September, the patient returned stating that he was passing some urine from his right rectus wound and during the past weeks they have been trying to close this leak by using an indwelling catheter. It looks as if this might prove successful.

This case is presented with these numerous facts because of the rarity of operative interference in ascending renal and ureteral tuberculosis, and to show how difficult it is to diagnosticate renal involvement when a tuberculous prostate is pouring tubercle bacilli into the urinary stream. Under such circumstances contamination of the kidney specimens is so likely to occur that the guinea pig test almost regularly will be positive on the kidney specimens, and at times the contamination may be so gross that the slide examination may be positive due to contaminations in transit from the cystoscopic sheath through the carefully washed bladder into the ureters.

#### BILATERAL NEPHROLITHIASIS<sup>1</sup>

DR. EDWIN BEER presented a woman who had been the subject of bilateral nephrolithiasis. A right nephrectomy was done for calculous pyonephrosis, and a left nephrotomy and partial decapsulation for

<sup>1</sup> Case recorded in part, *ANNALS OF SURGERY*, October, 1916, p. 456.

## BILATERAL NEPHROLITHIASIS

stone. A second nephrolithotomy and decapsulation for stone recurrence was performed. Then a tertiary nephrotomy and decapsulation, with permanent kidney drainage.

She was first admitted to Dr. Gerster's service in Mt. Sinai Hospital in 1912, and in October and November a two-stage nephrectomy for right calculous pyonephrosis was performed. At that time the patient's X-rays showed the stones in the right kidney—two stones in the right kidney; in the other kidney apparently as yet no deposit.

The patient was readmitted to the hospital in 1914; and at that time in her left kidney, just below the rib, there was a very distinct shadow, with all the symptoms of nephrolithiasis. She developed an anuria, with pyelonephritis. The anuria was relieved by passing a ureteral catheter. The temperature continued around 105° and 106°, so that on September 18, 1914, a decapsulation was done, together with a nephrolithotomy with drainage. The patient made a satisfactory recovery, and the wound healed. There were repeated attacks of pyelonephritis during the subsequent months, and the stones reformed. As the subsequent stones reformed, they formed casts of this kidney and pelvis. During this period the patient was carefully studied, both with the object of controlling stone formation, and with the object of determining her renal capacity. From the time of that operation—September, 1914—until June 5, 1915, when they were compelled to reopen that kidney, repeated tests of kidney functions showed a gradual diminution in output of phthalein, as well as of indigo-carmin (for test results see page 456, *ANNALS OF SURGERY*, lxiv). On June 5, 1915, during another attack of fulminating pyelonephritis, with high temperatures, a second nephrolithotomy and decapsulation was performed. Prior to that operation, the patient evidenced all of the signs of renal insufficiency—continuous vomiting, high blood urea nitrogen and incoagulable nitrogen, and markedly diminished in output tests. This operation was done under spinal anæsthesia, so as not to affect the remaining parenchyma of the kidney; and the patient made a satisfactory recovery, without developing uræmia.

After that operation, he determined to keep a permanent tube as a safety valve in the kidney, so that in case new stones tended to form, they might be washed out in an embryonic state—as well as to control the infection. Unfortunately, the tube was allowed to come out and was not replaced, after having been in place about two months. Then the patient, with the sinus closed, developed again anuria, which was relieved by ureteral catheterization, catheter passing by the stone and entering the pelvis. Since March, 1916, she is wearing a catheter in

her left kidney; and during this time the kidney pelvis and ureter have been regularly washed into the bladder, providing thus a double outlet. Now, no stagnation can take place, and it seems as if it was possible to control in this way the development of acute pyelonephritis, since, by avoiding all damming back against the kidney and all stagnation in the pelvis, it looks as if infection of the parenchyma were controlled.

Under this therapy the patient has gained some fifteen pounds; she has improved markedly in general health, and the resuscitated solitary kidney has increased the phthalein output to 37 per cent. A recent X-ray which was taken about a month ago shows that despite this permanent drainage there seem to be two small deposits in the kidney, probably renal calculi, although they may be calcification along the drainage tract. Those shadows are altogether different from shadows which had developed in the same period of time after the second and after the first nephrotomy and drainage. These stones, as far as symptoms are concerned, seem quite harmless as long as the secondary pyelonephritis is prevented by permanent drainage.

#### FRACTURE OF LOWER ARTICULAR SURFACE OF HUMERUS

DR. WILLIAM DARRACH presented a woman sixty years of age who on February 2, 1916, fell on the ice. She apparently had her elbow flexed at right angles with her forearm across her abdomen and struck directly over her elbow. Three days later she came to the Presbyterian Hospital for treatment. At that time the left elbow was greatly swollen, with marked ecchymosis. A lateral X-ray plate showed the presence of a fragment with a semicircular outline lying above the coronoid and in front of the lower humerus (Fig. 1). The anteroposterior view showed the same fragment to be just above the region of the trochlea. The lower margin of the articular surface seemed normal in outline except for the absence of the external trochlear ridge. There was a line of fracture to be seen above the capitellum.

Five days after the injury under 1 per cent. novocaine an antero-external incision 12 cm. in length was made along the inner margin of the brachio-radialis and deepened through the deep fascia. The muscle was retracted outward exposing the musculospiral nerve. The brachialis anticus was split 1 cm. to the inner side of the nerve and the capsule opened vertically down to the tip of the coronoid process. The line of fracture separating the capitellum could be made out but there was almost no displacement of the fragment. The loose fragment was found to be completely separated from all its attachments. It was rotated around and an attempt made to force it back into position. This

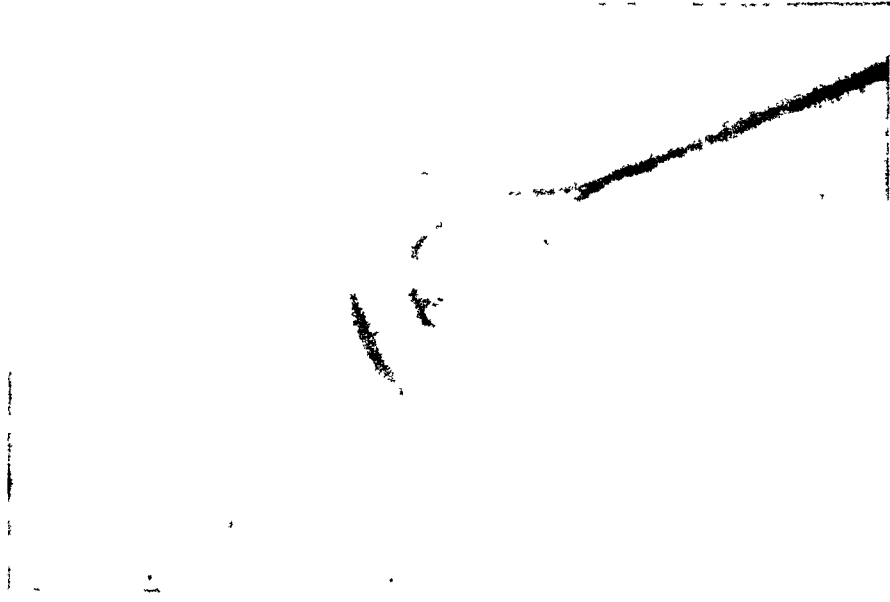


FIG. 1.

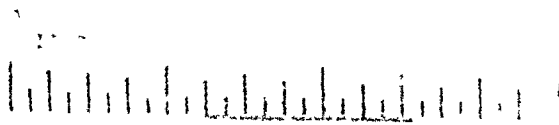


FIG. 2.



was so painful that she was given nitrous oxide and a second attempt made, which was unsuccessful. The fragment was then removed. Flexion was immediately possible to  $45^{\circ}$  and extension to  $170^{\circ}$ . The brachialis anticus was sutured with plain catgut as was the deep fascia. Skin was closed with silk and the elbow bandaged at  $90^{\circ}$ . The nitrous oxide was stopped as soon as the fragment was removed. The fragment consisted of the anterior two-thirds of the whole trochlea (Fig. 2), the line of fracture being almost vertical.

The wound healed primarily and motions and massage were begun after ten days and kept up for fourteen weeks.

On April 4, she had flexion to  $80^{\circ}$  and extension to  $140^{\circ}$ . On October 5, 1916, she could flex to  $75^{\circ}$  and extend to  $150^{\circ}$ , there was four-fifths the normal amount of pronation and three-quarters of supination. There was a little gritting sensation, without pain, on flexion and extension. She can reach the back of her neck, the back of her waist band and can arrange her hair.

The case is reported because of the rarity of fracture of the trochlear surface and because the greater part of the operation could be done under local anæsthesia.

## OPERATIVE TREATMENT OF INTESTINAL OBSTRUCTION

DR. CHAS N. DOWD read a paper with the above title.

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*Stated Meeting, October 25, 1916*

The President, DR. CHAS. N. DOWD, in the Chair

## PAGET'S DISEASE OF THE NIPPLE

DR. WALTON MARTIN presented a woman, sixty-one years old, whom he had first seen three years ago. She was referred to him for an erosion of the nipple of the left breast. There was a small area on the side of the nipple, sharply defined covered with a crust. From time to time the crust would fall off leaving a raw surface with a viscid exudation. The condition had been present for several months. On examination of the breast no tumor was palpable, although the patient said that since the birth of her child, 30 years ago, she had noticed a small lump behind the nipple.

The nipple, underlying fat and an elliptical area of skin were removed. Microscopical examination of the eroded area on the nipple showed simple inflammatory changes. There was no evidence of carcinoma of the underlying tissue, nor of epithelioma of the skin.

About two years later the woman returned with a hard irregular mass in the breast beneath the scar of the excised area. There were enlarged glands in the axilla. The breast, cellular tissue, lymphatics of the axilla and the pectoral muscles were removed. The woman made an uneventful recovery, the wound healed by primary union. Macroscopical examination showed a tumor 2.5 cm. by 5.5 cm. in the breast tissue.

Microscopical examination showed the typical structure of a scirrhous carcinoma. The lymph-nodes were invaded by the neoplasm.

Dr. Martin said he showed the patient, as she presented the sequence of lesions referred to by Sir James Paget in a paper published in 1874, under the title of Disease of the Mammary Areola Preceding Cancer of the Mammary Gland. Paget had noticed fifteen instances in which, in women between forty and sixty, there had been an eruption on the nipple or areola, looking like eczema excepting that in the majority of instances it was more intensely red, which showed no tendency to heal, and which in every instance that he had watched was followed by cancer of the mammary gland within two years.

Since then much has been written on the subject. But more emphasis has been laid on the character of the skin lesion than on the curious sequence of events observed by Paget. Handley, however, offered a rational explanation. The chronic eczema of the nipple is merely a secondary manifestation of impaired lymphatic return from the skin of the areolar district, produced by a scirrhous carcinoma too small to be palpable.

In any event a middle-aged woman with a unilateral chronic intractable eczema of the nipple, should be frequently examined, at least every month. Had he, he said, done so in this instance he might have detected this tumor when it was much smaller, and possibly before the involvement of the axillary nodes.

#### PRIMARY MELANOSARCOMA OF THE RETRO-ORBITAL TISSUE

DR. HERMANN FISCHER presented a woman, aged thirty-eight years, who was admitted to the hospital September 18, 1916.

About nine months before patient noticed that her left eye became swollen and that she had double vision, with impairment of vision of the left eye. She never had much pain, except for spasmodic sharp pains which occasionally shot across her forehead. The swelling and bulging of her left eye had continued to get worse and vision had become worse. Pain had not increased to any appreciable extent.

Examination of patient showed the following condition: The right eye was normal to all appearances. There was a marked exophthalmus

of the left eyeball. The movements of the eyeball, however, were not impaired. Pupils react to light and accommodation. Ophthalmic examination shows a choked disk, no other abnormalities. No signs of intra-ocular tumor formation. Vision on left side: Finger counting at one meter. Wassermann reaction negative. All other organs of the body without anomaly. Diagnosis: Retro-orbital tumor. It was planned to extirpate the tumor with preservation of the eyeball, if the growth proved to be benign. A Kroenlein operation was done. After retracting the orbital bone-flap a pigmented lobulated soft tumor protruded which occupied the orbital tissue posteriorly and to the outer side of the bulbus. It had extended into the temporal fossa where some coal-black streaks of pigment could be seen infiltrating the temporal muscles. There were, however, no tumor masses involving the muscular fibres. It looked more as though some black powder had been sprinkled upon the tissues. The whole tumor could be shelled out from the orbit with comparative ease. It had the size of a plum. After removal of this mass it was noticed that another small growth was closely attached to the episcleral tissue but had not pierced it. This tumor surrounded the optic nerve and had grown through the optic foramen along the sheath of the nerve towards the anterior cerebral groove. With a small Volkmann's spoon he entered the optic foramen and removed all of the pigment masses that he could reach. As there was no doubt about the malignancy of the tumor he decided upon the complete clearing out of the orbit, leaving nothing but the bony wall. The ciliary margins of the eyelids were then extirpated and the eyelids sewn together and used as a skin-flap to cover the orbit. The bone-flap was put back and a gauze drain inserted into the depth of the orbit.

The first two days after operation the patient was fairly comfortable. On the third day the patient complained of a headache. At 4 P.M. of the same day the temperature rose to 102.2. In spite of the rise in temperature the patient had been fairly comfortable when at 1.30 A.M. she suddenly fell into convulsions, with contractions of right side more marked than on the left. She had seven convulsions without once regaining consciousness. The next day patient felt much better, she had no headache and did not vomit. Temperature at 8 P.M. was 102.4. That night (fifth day after operation) she slept well. Toward morning stiffness of neck and pain were complained of. There was a moderate foot clonus and a positive Kernig on both sides and a moderate rigidity of both arms. Lumbar puncture showed 20 c.c. of yellowish, slightly turbid fluid. Examination of this fluid showed 114 cells and globular 2+, also *Staphylococcus albus*.



Wassermann reaction of spinal fluid was negative. After a few days all these symptoms improved and on the eighth day after operation, patient felt fairly well.

On microscopic examination the tumor proved to be a spindle-celled melanosarcoma. The tissues of the bulbous were free from the tumor.

Dr. Fischer remarked that primary retrobulbar tumors of the orbit are not very frequent and the pigmented type of the sarcoma is very rare indeed. Of 100,000 cases of eye diseases treated at the New York Eye and Ear Infirmary from 1897 to 1900 there were but twenty-four cases of primary orbital tumors. Schaaf found among 40,415 patients at the Giessen Klinik during twelve years only twelve primary tumors. The melanosarcomata of the orbital tissue start almost invariably from the tractus uvealis, and are, therefore, intra-ocular tumors. Melanotic tumors are only observed in such localities, where under normal physiological conditions, pigmented cells are found. It is probable that in this case the tumor took its origin from the pigmented cells of the sclera which are frequently found around the place of entrance of the posterior ciliary nerves.

#### TRAUMATIC HÆMOTHORAX. SIPHON DRAINAGE

DR. JAMES H. KENYON presented a boy, ten years old, who was knocked down by a truck on May 23, 1913. On admission to the Fordham Hospital shortly after the injury, he was found to be suffering great dyspnoea, he was deeply cyanosed, with a drawn, anxious expression of the face. There was marked subcutaneous emphysema of chest, back, shoulders and neck. Eyelids were œdematous. The pulse was rapid and thready. There was a fracture of the right clavicle at the junction of the outer and middle thirds, also a fracture of second, third and fourth ribs. There was tympany over the right side of chest with diminished breath sounds.

Oxygen gave no relief, and all symptoms were rapidly becoming worse. With novocaine a small incision was made just below the right clavicle—just through the subcutaneous tissue, not into the chest cavity. This diminished the surrounding emphysema.

Another small incision was made in the fifth intercostal space in the mid-axillary line. This was followed by an outward rush of air, and a small amount of blood as the pleura was opened.

A rubber tube, one-quarter inch in diameter, was inserted to the depth of one and one-half inch. The tube made an air-tight fit in the opening and was long enough to terminate below the level of sterile water in a bottle by the side of the bed. This water trap permitted the escape of air and blood from the pleural cavity, thus restoring the

normal pressure conditions. The condition immediately improved. Dyspnœa and cyanosis rapidly disappeared, and the emphysema became less.

The following day the patient was very comfortable, with no cyanosis, breath sounds normal, the air in the pleural cavity gone, and no longer any bubbling in the bottle. Emphysema decreased. The pulse was strong but the temperature  $102^{\circ}$  on that day. The temperature dropped to normal on the following day. On the third day the tube was removed and, as there was no discharge noted, the wound was strapped. The patient was allowed up on the fourteenth day and was discharged as cured on the sixteenth day after the injury.

DR. WILLY MEYER commented upon the method of siphonage used by Dr. Kenyon, saying that last winter at the Post-graduate Hospital he operated on a patient in whom he tried this drainage for the first time. It was one of those unfortunate cases in which the cancer was situated behind the aortic arch. After the tumor had been loosened and brought in front of the arch, it was seen that the tumor had broken through the œsophagus posteriorly, and had surrounded the vena azygos—which had to be ligated—a tremendous addition to the operation. But the patient pulled through the very extensive operation. We had made the incision through the seventh intracostal space, then cutting the ribs posteriorly. Back in the thorax in the ninth intercostal we inserted Dr. Kenyon's tube. We used a metal tube, which was compressed for a short distance, corresponding to the intercostal space, not round, but flattened; and outside it again continued in the regular round shape. We put a long cigarette drain into the bed of the œsophagus and passed it through and out of the tube at the end of which it was fixed with a thread passed through holes bored through so that we could unite the drainage with a bottle placed under the bed. In the number of hours the patient lived the apparatus worked very nicely; we saw that a good deal of sanguinolent fluid was discharged.

DR. W. S. SCHLEY said that he had published the results of his work on "aspiration drainage" in a series of cases in the *American Journal of the Medical Sciences* in 1908. He had tried it in a series of cases at the hospital in empyema, both in infants and in adults. The process of clearing the pleural cavity of pus and air was not only much accelerated and the recovery of the patient much hastened, but the after complications and the sequelæ, of persistent cavities, sinuses and possible infection of the rib, are diminished. Those cases did extremely well. He had not used it in an acute traumatic case with blood and air in the pleural cavity, and thought this to be very pretty application in thoracic surgery. But for the pus cases he had used it for many

Patient was admitted to the Neurological Institute on August 2, 1916. Examination showed a scar over the right forehead near the hair line. Otherwise the physical examination—urine, blood, spinal fluid, eye grounds, X-ray—was negative.

On August eighth he was operated upon and a large osteoplastic flap cut with the circular saw protected by washers, exposing the area from anterior to the scar to a point posterior to the motor area.

The bone was not depressed nor thickened. The dura was moderately tense, thick and white. Upon incising the dura considerable spinal fluid escaped and the cortex seemed slightly congested with a few grayish patches and signs of old exudate along the vessel walls. In the posterior frontal region several adhesions between the cortex and the dura were found. These were cut. A portion of the thickened dura, about one and one-half inches in diameter, including the area where the adhesions were found, was excised. The flap was replaced and the wound closed. The sutures were removed on the seventh day and the patient made an uneventful recovery. There was primary union and he left the hospital on the tenth day. Since the operation there have been no attacks nor headaches and the general condition of the patient has been excellent. The time which has elapsed since the operation is much too short to claim more than a temporary improvement. In this case, however, the pathological findings were so definite and the symptoms so marked and apparently lasting that an early exploration in these traumatic cases seems warranted.

DR. JOHN DOUGLAS said that about a year and a half ago he showed a patient before the Surgical Society on whom he had done an osteoplastic flap resection for traumatic epilepsy, in which he removed the thickened dura and replaced it with a flap made from the fascia lata and fat of the leg. At the time he showed this patient he had had no return of his epileptic convulsions. He saw him again within the last month; that was twenty months after his operation, the operation being done in December, 1914. During that time, although he had some twitching in his face, he had but one convulsion, which had occurred two weeks before he was last seen. He did a similar operation on another patient at Bellevue Hospital. This man left the hospital free of convulsions, but about two months after he left the hospital he had an attack of hemiplegia with paralysis of the side of the body on which he had previously had the convulsions. He returned to the Bellevue again last summer with a high temperature and a questionable diagnosis. He finally died, and at autopsy was found malignant endocarditis. At the autopsy they had the opportunity of opening his skull, and found that all of the fat which had been left on the flap

with the idea of preventing adhesions to the cortex after the removal of the thickened dura had been entirely absorbed. The new flap which he had put in to replace the dura was densely adherent to the cortex as well as densely adherent to the bone of the osteoplastic flap.

DR. TAYLOR said that if a man has an injury to his head and then has epileptic convulsions, it is only fair to give him a small chance of permanent recovery which may result from cranial exploration. A case in point is that of a young man who was playing baseball, and while running to second base received the knee of the second baseman in the left squamous bone; and he maintained the imprint of that knee in his head over the succeeding year. He had been advised by his neurologist to have his head shaped out again to relieve the traumatism which had necessarily occurred to his brain, but they put it off for a year because he had had no discomforts and no symptoms. At the end of a year he began to have epileptic convulsions which came with rapidly increasing frequency. Finally at the end of about fourteen months from the time of his injury an osteoplastic was done on the left side of his head, which revealed that the whole squamous bone and a large part of the parietal bone had been jammed in so that they were nearly two inches below the proper level. Not only had the dura been rounded in in the same way, but a splinter of bone two inches long had penetrated the tip of the temporal lobe and had caused a good deal of induration in the brain tissue and a good deal of adhesion to the dura. The dura was loosened, the fragment bone was removed; nothing further was done. The bone fragments were replaced so that instead of giving the imprint of the knee inward the head shaped out again to its proper position. That man got a good primary union; his bone held in place so that his head was again symmetrical. And since that time, which is now two years, he has never had a convulsion; his mind, which at times was a little bit hazy, his vision, which at times was not quite satisfactory, have entirely cleared up so that he is back at business; he can now drive his automobile with safety and he is perfectly normal so far. Now that is over a period of two years, and it seems to him, therefore, that one should not be too pessimistic. If one out of twenty people can be saved from persistent epileptic attacks it is well worth exploring the whole twenty in order to get the one.

DR. WILLY MEYER said that in the early nineties he had such a case, where a man had been struck by a big piece of wood over the motor areas of one side. He had a typical Jacksonian epilepsy, and at that time they found by laying the parts open that there had been a communicative fracture and adhesions existed between dura, brain and bone. At that time we were not so far advanced in homoplastic surgery,

so we did heteroplasty with celluloid. He made a good recovery and was free for two years, when slight epileptic attacks returned, always in his right arm. A neurologist who saw him at that time advised the excision of the centre, which was done afterwards, and again a piece of celluloid implanted. For a number of years the man was perfectly free of trouble. But it didn't heal this time so nicely; we had to remove the celluloid. He is now down in Texas, and two months ago a letter was received stating that he had his old attacks again.

MIGRATION OF A SHELL FRAGMENT FROM THE RIGHT FEMORAL  
VEIN TO THE RIGHT VENTRICLE OF THE HEART;  
GENERALIZED GAS BACILLUS INFECTION

DR. H. H. M. LYLE presented a heart, a shell fragment and a vein with the following history:

The patient, Francis Alary, 8th Zouaves, was brought to the Ambulance June 16, at 3.30 A.M. Four hours previously he had received a perforating sheel wound of the left thigh 4 cm. above the knee, and a penetrating shell wound of the right thigh. A fluoroscopic examination of the thigh and abdomen failed to reveal any foreign body. The upper abdomen and thorax were not examined. The failure to find the shell fragment was puzzling, as the depth and direction of the wound seemed to preclude the possibility of the particle having fallen out.

The patient was in a condition of mild shock. Temperature  $97.2^{\circ}$ , pulse 126, respiration 28. Examination of the chest and abdomen were negative.

*Operation.*—The contused skin edges were cut away, the wound laid open, and the projectile tract lightly but methodically excised. No foreign bodies were discovered. At the bottom of the wound of the right thigh the femoral vessels were found embedded in a blood clot, the femoral vein was bruised but apparently intact. Four Carrel instillation tubes were inserted and 20 cc. of Dakin's solution were delivered to the wound every two hours.

The patient appeared drowsy and slept the major portion of the first two days. On the third day his abdomen became greatly distended and he complained of pain and tenderness over the spleen and right kidney. The distention was partially relieved by lavage and enemata. Jaundice appeared on the morning of the fourth day and was accompanied by pain and tenderness over the liver. The temperature rose to  $102.2^{\circ}$ , the pulse to 132 and the respiration to 32. Fine moist râles were heard at the left base. The area of cardiac dulness had increased, a distinct pericardial rub was heard, and the cardiac sound was indistinct. A provisional diagnosis of general gas bacillus infection with

pericarditis and pneumonia was made. In the afternoon there was a temporary improvement followed by sudden death at 5.30. Throughout the course the wound remained sterile.

*Autopsy* (Dr. Proctor).—Body of a man thirty-one years of age, moderate frame, fairly well nourished. Skin deeply jaundiced. No wounds of the abdomen or thorax. Wounds of the thigh clean. The wound of the right thigh is 10 cm. below and 5 cm. posterior to the anterior superior spine of the ilium. The tract leads forward, downward and inward to the femoral vein. In the external wall to the vein there is a small valve-like wound sealed by an organized clot. No local evidence of gas infection. Both lungs are œdematous, there is a fibro-purulent pericarditis with free gas in the pericardial cavity. The heart is enlarged and its external surface covered with a fibro-purulent exudate. The cut section of the heart gives a gaseous crepitation. There is a rough shell fragment free in the cavity of the right ventricle. The shell fragment measures 1.5 cm. in length, 0.9 cm. in width, and 0.5 cm. in thickness, and weighs 1.81 grammes. There are fibres of clothing adherent to the irregular surface of the shell. The liver, spleen and kidneys are enlarged. On cut section all give gaseous crepitation. There is no obstruction to the gall-bladder or gall-ducts.

*Revised Diagnosis*.—Perforating wound of the left thigh, penetrating wound of the right femoral vein, migration of the shell fragment to the right ventricle of the heart. General gas bacillus infection. No local infection of the wound.

Beside the extreme rarity of the case the following points are worthy of notice:

1. The carrying of a rough shell fragment by the blood stream from the right femoral vein to the right ventricle, the patient living four days and eighteen hours.

2. The sealing up of the wound in the vein.

3. The sterilization of the local wounds by the Carrel method, the generalized gas infection having undoubtedly arisen from the clothes on the shell fragment.

4. A fluoroscopic examination of the upper abdomen might have revealed the presence of the shell fragment. It then would have been a simple matter to have milked the fragment into an unimportant vein from where it could have been easily removed. This has already been done in the case of a shrapnel ball.

DR. H. FISCHER presented the specimen which he had removed from a woman a few days ago. For some time this patient has suffered

from indefinite abdominal pains in the lower abdomen. She has never been acutely ill. For several years she has had a small umbilical hernia that has given her some pain lately.

The patient is extremely stout and has a large pendulous abdomen. There is present a small umbilical hernia that contains some omentum which cannot be reduced. There is some pain on palpation. In the right lower abdomen there can be felt a tumor of about the size of an orange. This tumor is freely movable, a little painful on pressure, and is of cystic consistency. On bimanual palpation the uterus and left adnexa are found to be normal, on the right side the same tumor can be felt. The diagnosis was, therefore, cyst of the right ovary. On opening of the abdomen it was found that this cystic tumor was formed by the appendix. Its walls were extremely thin and its lumen distended by a thin fluid. The tumor, when delivered from the abdomen, was of the size of a large orange.

Some years ago I operated on a similar case. In this case the cystic appendix was of the size of the small intestine and had caused a colo-colic invagination into the transverse colon. It was filled with a thick mucus.

In both cases it must be assumed that the cyst formation was the end result of chronic inflammatory changes.

#### WARREN INCISION FOR THE EXTIRPATION OF BENIGN TUMORS OF THE BREAST

DR. A. V. MOSCHCOWITZ presented a woman from whom an adenofibroma the size of a pigeon's egg, located in the upper and outer quadrant of the breast, had been extirpated through a short-curved incision at the outer margin of the breast.

All incisions of this nature heal very kindly; the cosmetic result is excellent. Dr. Moschcowitz warmly recommends the incision for all operations of this nature.

#### STEWART INCISION FOR THE RADICAL AMPUTATION OF THE BREAST FOR CARCINOMA

DR. A. V. MOSCHCOWITZ presented two patients whose breasts had been amputated for a carcinoma by the incision and method described by Stewart, and published in the *Transactions of the American Surgical Association* for 1915. As the history and physical examination do not present anything out of the ordinary they were not given.

These two cases were presented principally in order to get an expression of opinion regarding the adequacy of the incision from those

members of the Society who have used it. In Dr. Moschcowitz's opinion the final result as regards healing of the wound, cosmetic appearance of the cicatrix and function of the arm has been ideal in every respect. In fact the only drawback Dr. Moschcowitz found is that the operation is not as easily done as in the Halsted-Willy Meyer operation; and that in consequence there is at the termination of the operation a lack of that complete satisfaction of having really done a complete and thorough block dissection.

As a result of his all too limited experience Dr. Moschcowitz would say that it would be perhaps preferable to restrict the incision to very early cases, and to those in which the cosmetic result is of such importance as to overbalance other considerations.

## CARCINOMA OF THE BREAST WITH VERY LATE METASTASIS IN THE OPPOSITE AXILLA

DR. A. V. MOSCHCOWITZ presented a woman, fifty-three years of age, who was referred to him June 6, 1916, when the following history was obtained:

Fourteen years ago amputation of the right breast for a carcinoma. Thereafter the patient was perfectly well up to a few months ago, when she began to complain of a drawing sensation, at first upon the right side of the neck, and then upon the left. These complaints were so trivial that she did not even consult her family physician up to a few days ago. When she did so, however, he discovered a tumefaction, the size of a fist, in the left axilla, whereupon he promptly referred her to Dr. Moschcowitz. By examination he found a perfectly smooth, pliable, non-adherent scar of an amputation of the right breast. The left breast was slightly pendulous, and upon repeated and very painstaking palpation, revealed absolutely nothing pathological. The left axilla was the seat of a tumor the size of a fist, composed of a number of apparently discrete glands, varying in size from those barely palpable to that of a plum. The skin was not adherent, nor was the mass adherent to the deep structures. It was neither painful nor tender. The rest of the physical examination was absolutely negative.

The history of the case, the length of time that had elapsed since the primary operation, and the absence of anything of a pathological nature in the left breast, as well as the physical nature of the tumor itself, led him into the error to exclude a diagnosis of a metastatic carcinoma. He was more inclined to the diagnosis of a primary lymphatic tumor, or of Hodgkin's disease. He advised an exploratory incision, with immediate examination of a frozen section.



Dr. Moschcowitz operated upon the patient on June 21, 1916, through an incision parallel with the outer edge of the pectoralis major, and extirpated a good-sized characteristic gland. Dr. F. S. Mandlebaum, Pathologist of Mount Sinai Hospital, reported that the specimen removed consisted of a large fused mass of lymph-nodes about the size of an orange, the individual nodes varying in size from a bean to a large plum. The freshly cut surface of the nodes is pinkish in color, rather firm in consistency, homogeneous in character, and presents the general appearance of a lymphosarcoma or some primary tumor of the lymph nodes.

In his opinion the diagnosis of metastatic carcinoma secondary to a primary mammary tumor arising in the ducts can be established in this specimen. In view of the fact that this patient had the breast of the opposite side removed many years ago, and inasmuch as there is no palpable tumor present in the remaining breast, he felt reasonably convinced that these nodes are secondary to the original tumor. Metastases in the axillary region of an opposite side are not the rule, but such conditions are not unknown. Although this form of carcinoma is somewhat uncommon, the records in the Pathological Laboratory of Mount Sinai Hospital show more than fifteen cases of carcinoma arising from the epithelium of the ducts. In some of these cases the axillary lymph nodes were involved, in others no metastases could be found. A patient recently operated upon by Dr. Moschcowitz in whom the axillary nodes were involved showed the same histological picture as that present in this case.

Dr. Moschcowitz himself stated that the freshly cut gland did not in the least resemble the usual picture of a carcinomatous gland. He, therefore, did not disturb the breast, but contented himself with the extirpation of the entire mass of glands from the axilla. He was more than chagrined, therefore, to learn a few days later from Dr. Mandlebaum the true nature of the glands.

A very minute examination of the thorax a few days later revealed to the right of the manubrium of the sternum an area of dulness about the size of a silver dollar. Dr. Jaches was good enough to X-ray the patient for him and they were able to obtain upon the X-ray plates the shadow of a tumor which shows up particularly well upon stereoscopic examination. A print of the X-ray plate (Fig. 1) and the report of Dr. Jaches are hereby appended:

"The Röntgen ray examination (fluoroscopic and radiographic) of the chest of Mrs. F. J. shows the following: In the upper portion of the right chest, corresponding in position to the second costal cartilage anteriorly, there is a circular shadow about one inch in diameter. On an

## CYSTIC MASTITIS

oblique examination this shadow is seen to be situated in the posterior mediastinum just behind the arch of the aorta. This shadow has the appearance of a large mass containing calcareous deposits, and is strongly suggestive of a new growth. Otherwise no abnormality is seen in the chest or in the bones of the thorax."

The case is presented on account of the following features:

1. The very late (after fourteen years) occurrence of metastases after an amputation of the breast for carcinoma, without any local recurrence.

2. The location of the metastasis in the opposite axilla.

3. The presence of a small but undoubted tumor in the posterior mediastinum, as seen in the X-ray, which may account for the contralateral axillary involvement.

4. The rarity of the pathological findings.

5. The difficulty of the pathological diagnosis in the fresh state, as well as in a frozen section.

It is furthermore of interest to state that thus far there is no local recurrence. The patient has, however, developed a slight cough, which may be accounted for by irritation of the trachea by pressure from the mediastinal growth.

In connection with this case Dr. Moschcowitz presented also two other cases of carcinoma of the breast.

## CYSTIC MASTITIS

DR. PARKER SYMS read a paper with the above title for which see page 699.

DR. NATHANIEL GREEN said that in Dr. Syms's paper he has expressed himself as advocating a very radical removal of the breast with the muscles underlying it in these cases of chronic cystic mastitis. It seems that his position is the rational one in cases of thirty to forty years of age, but in the breasts of young women who are twenty or so it seems to me we can be more conservative. It was my privilege to visit the Mayo Clinic just a year ago and to see Dr. Judd operate upon one or two of these cases of chronic interstitial mastitis with cyst formation. The way I remember that he did it was to make an elliptical incision around the nipple and remove the whole gland down to the muscle; and he did not remove any more, neither the pectorals nor the axillary contents. I asked him if that were the thing he did generally in these cases. He said they had had about five hundred cases of this kind and they had followed that procedure with them. Sometimes they had been double, sometimes single. He said in the microscopical examination of these breasts a few of them had shown

changes, indicating early carcinoma, but there had been no recurrence in this particular class of cases, and none had gone further to carcinomatous progress.

DR. JAMES M. HITZROT said that he thought that there were a large number of women, especially young and unmarried women, who have cystic mastitis who would refuse the radical operation. In a number of these cases he has used the Thomas incision and had extirpated the breast subcutaneously leaving the nipple. The space left by the removal of the breast can readily be filled in for cosmetic purposes by a flap of fat obtained from the neighborhood and this transplanted fat will, to a certain extent, restore the breast contour.

The radical operation should be necessary in only a very limited number of cases, and in these one would find at the clinical examination sufficient data to advise the more extensive operation. A careful examination of the gross specimen at the time of the removal should reveal the evidence of malignancy and would furnish sufficient check upon the operation.

The time limit is entirely too short in my experience to say much about recurrence in the case treated by the method given above, but so far there have been no cases of cancer or of recurrence in the cases thus treated. Some of the breasts removed have shown histological pictures which resembled closely the case shown in Dr. Syms's slides, *i.e.*, the case with the acini filled with cells exhibiting marked hyperchromatism.

DR. WM. B. COLEY said that his experience was entirely in accordance with Dr. Hitzrot's, and as a matter of record he would state that he did not recall a single instance in which he had removed one of these chronic mastitis tumors and primary tumors with recurrence. It would be extremely practical to remove the entire breast and pectoral muscle in young women, women under thirty, for this condition, because I don't think we have any facts or any evidence to warrant any other procedure.

DR. JOHN A. HARTWELL remarked that statistics from Boston, already quoted by Dr. Syms, show that four cases out of about eighty-eight who had had a partial operation for chronic cystic mastitis, later developed cancer. This is hardly a greater number than might be expected among eighty-eight women who had never had cystic mastitis. The cases above cited were operated upon by several surgeons. In some only a very local excision of the most diseased portion of the breast was done, while in others a complete mastectomy was restored to, but in no case was a radical operation as done for cancer performed. In his opinion, the radical operation, with removal of pectoral muscles

## CYSTIC MASTITIS

and extensive axillary dissection, is not needed in the disease of chronic cystic mastitis. Even in those cases where hyperplasia is marked, and the lesion might be considered as showing some resemblance to beginning cancer, there is no indication for anything more than a complete mastectomy, because the disease, even when so advanced, is purely local, and has not yet developed a power of distant invasion.

Concerning Dr. Moschcowitz's case with the axillary lymph nodes, he hesitated to make a suggestion, but the X-ray plates suggested to him that the tumor in the mediastinum is a carcinoma of the thymus gland, the axillary involvement being metastasis from it. This suggestion was brought to his mind by recalling a case exhibited by Dr. Ewing last winter, and the microscopical sections exhibited by Dr. Moschcowitz are, as he says, rather unusual for breast carcinoma. (With Dr. Moschcowitz's permission the X-ray plates and sections were shown to Dr. Ewing and his opinion conformed to that given by Dr. Moschcowitz, namely, that it is a late metastasis of a duct cell carcinoma in the right breast. He says that the X-ray findings in the thymus tumors are much larger, much more pyramidal in shape, less nodular and extend higher in the neck.)

DR. W. S. SCHLEY referring to Dr. Moschcowitz's case of late recurrence after breast amputation said that the question of a time limit is, as is well known, out of date. He remembers a case of recurrence after thirteen years directly in the scar on the chest the size of a twenty-five cent piece. An excision of that was followed a year later by a second recurrence at the lower end of the scar; and a year after she died of metastasis in the spine, sixteen years after her original carcinoma of the breast. That was a long delayed recurrence, undoubtedly left-over cells. He believes in a number of our breast amputations that cancer cells are left even with wide skin excision, which should certainly be practised. In certain cases they remain probably walled in by scar tissue to develop later. He cannot but feel that the general condition of the patient plays a part, as in the above case where the carcinoma reappeared with the failing health of the patient due to curtailment of care and nourishment from altered circumstances. Its recurrence in the opposite axilla in the case presented has some unique features.

As regards all cases of cystic disease of the breast, the process is essentially benign in character. Does carcinoma occur in these cases any more frequently than it occurs in the breast that is not the seat of cystic disease? A certain number of them, a very few of them, will show early carcinomatous changes, but we see infinitely more cases

of carcinoma of the breast where the carcinoma is the whole thing and apparently the rest of the breast is not involved in any benign process. The process varies from individual simple cysts through multiple cysts up to the complex derangements with tumor formation. Where to draw the line in our surgical work is often difficult. Surgeons are frequently justified in conservative operations. A single or even multiple cyst formation does not necessarily call for complete extirpation. In a cystic degeneration, so called, of the breast with innumerable multiple cysts, multiplication of the cellular element and the intra-cellular substance, extirpation is certainly indicated, partial or complete. A partial or complete resection of the breast is the proper procedure for all benign tumors of the breast, except the simple thin-walled cyst; not so much for fear of cancer degeneration as that we have a progressive process. There are a number of these simple cysts that occur as an involution process, and one is justified by clinical experience in a conservative treatment of them. Associated discharge from the nipple always calls for more radical measures. Shepherd, of Montreal, is a strong advocate of conservatism in the case of simple cysts. He speaks from forty years' experience with many hundreds of cases treated by nothing more than aspiration. He has carefully followed these and says that not only they do not develop carcinoma but that the majority do not even require a subsequent tapping. It is, however, certainly a justifiable procedure to extirpate, and should always be done if any sense of thickening remains after aspiration, or if there should be coincident nipple discharge. In cystic disease, especially with thickening and evidence of a diffuse condition, partial or complete extirpation is certainly called for. The great majority of these benign breasts do not develop carcinoma, and it is questionable whether cases of cystic disease of the breast develop carcinoma any more frequently than breasts where no such condition exists. He did not advocate conservatism in all these various breast conditions, as nearly all call for operative interference, but thought we should have a proper appreciation of the pathology as well as of the possibilities.

DR. WM. COLEY stated that he had had one case of local recurrence of carcinoma in the breast seventeen years after the primary removal, and metastasis into the other breast, a case of about fourteen years.

DR. WILLY MEYER remarked, concerning Dr. Moschcowitz's rare case of recurrence, that he had often seen late recurrences, one for instance, eight years after a radical operation. He had seen three cases of cancer up near the axilla which proved to be affections of supernumerary mammary glands. With regard to the cases discussed by Dr. Syms, these cases certainly are precancerous in some instances.

He recalled one lady in the early forties who had such a tumor. A radical operation was refused and a simple removal of the tumor was done. She was well for ten years and then presented herself with a far advanced cancer of the breast. In one instance he had a patient similar to one that Dr. Syms mentioned where there was a local tumor, a fibro-adenoma, usually combined with cysts. Frozen sections were made; the report came, "benign." After further search, however, the report came in, "in the centre cancer." A radical operation was done, and the patient is to-day perfectly well. In another case where there was a large cystic tumor, but the patient was descending from a cancerous family—four, five or six members having had carcinoma—there was not the slightest sign of disease in the axillary gland. He urgently advised radical operation; it was done to satisfy the patient and keep her from worrying. The report came, after a most careful analysis, "perfectly benign."

Now, that gives us reason to think, particularly in the face of those positive statements Dr. Abbe has made again before the American Surgical Association last year, and lately D. Shepherd, of Montreal. With the simple operation done, sometimes the patients remain well. But in his own work if he had to deal with a patient in the real cancer age, say above thirty-five, never would he lend his hand to a simple surgical procedure as tapping. He would insist upon radical operation. If it is not accepted—that is for the patient to decide.

DR. H. B. DELATOUR thought surgeons should be guided by the history and condition of the patient. He had followed cases for fifteen years, both single and multiple cysts, and had yet to see a recurrence or development of carcinoma following in any.

The Stewart operation he had performed several times, and while it gives you a much better access to the axilla than one would naturally expect, one feels hampered, does not feel as if access to the axilla were as perfect as with the other operations.

DR. JOHN F. ERDMAN said that if the question of cystic fibrosis or cysto-adenoma, etc., is taken up, especially where there is a discharge from the nipple from the thin straw-colored to the bloody or very dark fluid, one cannot eradicate from the mind the idea that in some one or other of those cysts there is present a papillomatous outgrowth; and over forty per cent. of these papillomatous outgrowths, according to the reports from Massachusetts General and Johns Hopkins Hospitals, are reported as being malignant, primarily. Bearing that in mind, in all of these growths, it is his invariable rule to do a complete amputation of the breast without removal of the pectorals but dissecting off the fascia. In former years he was dissecting the breast out subcu-

taneously, retaining the nipple. The breast would fill up to a considerable degree. The patients who retained the nipple did not feel that they had sustained the mutilation that other women had. At the present time he does not save the nipple at all.

In regard to the Stewart incision, during the close of last winter's sessions in this Society, he reported twenty-three or twenty-seven, I have forgotten which, cases in which operations were made by means of the Stewart incision. Since that time he had done quite a number more. He finds no difficulties in exposing the contents of the axilla at all in the Stewart incision, but we are not able to take off the same amount of skin that we are in the ordinary Meyer operation. That is, if the growth extends up far you must make the Meyer operation type of incision rather than the Stewart. And Stewart also claimed that it was not used for all types of breast removal—that is, in the malignancies. But what he had found in this series of cases is that over seventy-five per cent. of them suffer a great deal of axillary pain. Nevertheless it is true that they suffer more pain immediately after and subsequent to the operation—that is, some months after—than in the ordinary incision. In abduction, with extension of the arm, there is a drawing on the flap which is adherent to the chest wall, and this they complain of.

Dr. MOSCHCOWITZ said that when Stewart reported his operation he mentioned that during the last five years he has operated forty cases by this method; in the discussion which followed, Gibbon reported forty-seven similar operations, and apparently with the greatest satisfaction. The radicality of the cure in Dr. Moschcowitz's case is not now under discussion; the elapsed time is far too short for that, and for that matter he is willing to concede, or at least hope, that the cases are cured. His main reason for presenting these cases was to get an expression of opinion regarding the exposure obtained during the operation. The method has undoubtedly a great many advantages, so that in spite of his present dissatisfaction, he will continue to use it; he is in hopes that the fault is his, and that with increasing experience he will overcome his present dissatisfaction.

As regards the case of recurrence of the breast carcinoma, he really did not present it so much as a case of late recurrence, but as a case of late recurrence in the axilla opposite to the involved breast. The histopathology of this case is so involved, that he refers the reader to the report of the pathologist. In reply to Dr. Hartwell, Dr. Moschcowitz merely wishes to add, that if Case I is a metastatic carcinoma in a gland—and of that there is not the slightest doubt—then the case under discussion being entirely similar to that, must also be a glandular carcinoma.

## CYSTIC MASTITIS

Finally, as regards the paper of Dr. Syms, Dr. Moschcowitz wishes to say that in all cases of carcinoma of the breast, his views are very radical, both as to the indications and as to the operation. But until a particular case is proven to be a carcinoma beyond any doubt he would be inclined to be somewhat more conservative than Dr. Syms. It also appears to Dr. Moschcowitz that Dr. Syms was somewhat hypercritical regarding the value of frozen sections. It is true that in a majority of the cases even a gross examination of the cut tumor will very quickly decide between the benign and the malignant tumors, but it is in the exceptional case in which the pathologist's opinion becomes valuable. Cases like the one presented by Dr. Moschcowitz to-night have been so rare in his experience as to be practically unique.

DR. SYMS, closing the discussion, remarked he tried to use judgment in each individual case as to whether there is indication for operation or not and, if an operation is decided upon, whether or not the operation should be a radical or a local one. He had not performed the radical operation in many of these cases.

But an academic consideration of this question is quite another thing. As one studies this remarkable disease one is impressed with its complex nature and with its progressive character. If the various processes represent progressive stages—inflammation, hyperplasia, tumor formation, cancer—then we must concede that it is only a question as to how far a given case progresses whether or not cancer will develop.

If that is so there will be made mistakes in trying to differentiate, for there are no symptoms that indicate a transition into cancer.

The statistics from the Mayo Clinic, as reported by Dr. Greene, are interesting, but they are not convincing. Keen observers have reported a varying percentage of cancer among their cases of chronic cystic mastitis. If their observations are true, it would mean that there must have been a number of cancer cases in the Mayo Clinic's list. If that is so, they have been employing an inadequate operation in the treatment of cancer of the breast. It cannot be claimed that simple amputation of the breast is the proper procedure in cases of carcinoma.

In considering this topic one must carefully distinguish between chronic cystic mastitis and true fibro-adenomata. The tumor-like masses found in chronic cystic mastitis are not true tumors; they are tumor-like masses; they are not encapsulated, isolated tumors; they cannot be enucleated; they are part of a complex process.

In case it is determined that the breast should be removed, simple amputation should be seldom employed. The radical ablation is no more disfiguring, no more disabling, and, in his experience, no more dangerous than the lesser operation.



# TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY

*Stated Meeting, held October 2, 1916.*

The President, DR. CHARLES H. FRAZIER, in the Chair.

## FRACTURE OF SKULL, DECOMPRESSION AND DRAINAGE

DR. NATHANIEL GINSBURG presented a youth, aged fifteen years, who was admitted to the Jewish Hospital, September 4, 1916, on account of a cranial injury sustained a half-hour previously. He was in partial stupor, with a rapid pulse which quickly slowed down to sixty beats to the minute while the examination was taking place. There was a large hæmatoma of the scalp to the right of the external occipital protuberance, with a rupture of the soft parts about two centimeters in extent, extending down to the bone. The pupils upon admission were equal, but within a short time, the right pupil became widely dilated, and the inequality remained marked. The skin was cold, and perspiration profuse. Vomiting at first of normal gastric fluid was quickly followed by fluid containing fresh blood, and was projectile in type. The oropharynx showed free bleeding from above. There was ecchymosis of the left upper eyelid, and a small hæmatoma was present over the left frontal region. The left ear was almost totally avulsed from its attachment. The patient had had one convulsive seizure.

He was immediately taken to the operating room, and lumbar puncture revealed intracranial hemorrhage, the fluid being deeply colored by blood. Under ether anæsthesia, the scalp was incised down to the bone, employing a vertical incision over the right occipital area, the incision extending equally above and below the line of the lateral sinus. A fissure fracture of the occipital bone was revealed with free bleeding externally. The skull was quickly opened by drill and rongeur forceps, the gutter in the bone extending to the superior limit of the break. The inferior extent of the fracture apparently passed into the foramen magnum and it was not deemed advisable to remove all the bone down to this point. Free bleeding from the diploic vessels was easily controlled by Horsley's bone wax. The extradural clots were wiped away and the dura was incised above and below the ten-

## FEMORAL ARTERIOVENOUS ANEURISM

torium, avoiding the lateral sinus and exposing the cerebral and cerebellar cortices. Blood-tinged cerebrospinal fluid under much pressure escaped, and the dural incisions about two centimeters each in length were not sutured. A small piece of rubber tissue was introduced down to the dura in the lower angle of the wound and the scalp sutured by interrupted iodized catgut and silkworm gut sutures. The drain was removed twenty-four hours later. The wound was dressed with gauze moistened with solution (1-4000) bichloride.

The nasal and oral cavities were sprayed hourly with an antiseptic solution, no packing of the nares being employed.

Except for free vomiting and extreme restlessness and headache during the first twenty-four hours, convalescence was uninterrupted, and the boy left the hospital well on September 17, thirteen days after the injury.

The important features of this case are prompt operation with drainage above and below the tentorium cerebelli, by dural incisions, frequent washing of the pharynx, and final recovery.

Dr. Ginsburg said that he resorted to immediate decompression with drainage above and below the tentorium cerebelli in this case, because he regarded the presence of free blood in the cerebrospinal fluid as evidence of intradural hemorrhage. The symptoms of cerebral compression were indisputable, and prompt relief of intracranial pressure would give the best chance of recovery.

Although he could not say that this patient would not have recovered without the prompt occipital decompression and the drainage which was thereby established, it was true that at the operation, the bloody cerebrospinal fluid, which escaped when the dura was incised over the cerebral and cerebellar cortices, was under great pressure, and rapid recovery ensued following decompression.

## FEMORAL ARTERIOVENOUS ANEURISM

DR. EDWARD B. HODGE presented a man, twenty-three years of age, who was admitted to the Presbyterian Hospital, April 3, 1916, with an egg-sized pulsating swelling in the right thigh, with a history that three months before admission, in a machinery accident, a piece of steel about an inch in length, had been driven into the inner anterior surface of his right thigh. Two days later, he noticed a non-painful swelling, egg size, near the site of injury. This had varied in size, but was now larger than at first. In the last three weeks, there had been a peculiar sore feeling on the inner part of the lower leg. The general examination was negative. About seven inches below Poupart's liga-

ment and in line with the femoral vessels, was an egg-sized pulsating swelling. A plain thrill was felt here and also over the femoral vessels as high as Poupart's ligament and for three inches below the tumor. There was a loud continuous bruit heard over the mass accentuated with the beat of the artery. This was also heard from Poupart's ligament as far down as the popliteal space. There was no tenderness nor pain nor was there tenderness over the "sore" area in the lower leg. Proximal pressure obliterated the thrill, while distal pressure had no effect. There was a good pulsation in both tibials.

*Operation* (April 7).—Under gas-ether. Tourniquet applied high upon thigh. On incising the soft parts, there was found much inflammatory reaction, matting the tissues together over and about the sac. The latter was located at the beginning of Hunter's canal. After considerable difficulty from the infiltration of the muscles and from oozing, the mass was cleared into healthy tissue above and below. Temporary tape ligatures were placed on both sides of the sac. The vessels were found tightly adherent for about two inches. The foreign body was felt posterior to them and was removed. It was found impossible to close the communication between vein and artery without opening the sac, as had been done in a previous case. The sac was incised and the vein found lying in front and to the inner side of the artery with a communication between the two about three-quarters of an inch long. There was considerable bleeding which could be checked by the provisional tape ligatures. An attempt was made to suture the communication from within the sac, but the tissues were so friable that the suture would not hold. After many attempts, this plan was abandoned and quadruple ligation with excision of the involved vessels was done. Hæmostasis was completed after the removal of the tourniquet and wound closed in layer suture. The operation was long, taking over two hours, due to the oozing and the many attempts to suture the opening. Patient had a rapid pulse at its conclusion, but soon reacted and had a normal convalescence, with a temperature of  $100.2^{\circ}$  for its highest. Two days after operation, the right leg was one and three-quarter inches larger than the left just above the knee. The elevated foot remained warm and of good color at all times, and on the eighth day, pulsation in the tibials was felt. He was discharged cured on the 17th day. The foreign body proved to be a piece of steel, shaped like an arrow head, about one-third of an inch long.

DR. JOHN H. GIBBON said that the application of a temporary ligature in the case of traumatic aneurism is feasible, but when dealing with an aneurism, the result of a diseased blood-vessel, the employ-

ment of such a ligature is dangerous. The failures and fatalities which have followed the performance of the Matas operation have been largely due to the injury produced at the site of the application of the temporary ligature. The most carefully applied temporary ligature may result in secondary aneurism or rupture of the vessel. He had operated upon a good many cases of aneurism of the popliteal and femoral arteries and in all he had used digital compression with the most satisfactory control of circulation. In one case of iliac aneurism, he first opened the abdomen and had an assistant control the circulation by digital compression. This is a safer and more intelligent method of control than either that obtained by ligature or tourniquet, as no damage can be done to the vessel. In cases such as Dr. Hodge reports, of course, the temporary ligature is less likely to do harm.

DR. J. STEWART RODMAN recalled a case in which he had the privilege of assisting Dr. Horsley, of Richmond, Virginia, operating at the Medico-Chirurgical Hospital.

This case was one of arteriovenous aneurism of the femoral vessels, in which Dr. Horsley, after much difficulty in freeing the vessels from surrounding tissue, performed a similar operation of separating artery and vein and restoring their calibre as reported in a previous case of Dr. Sweet and Dr. Hodge (*ANNALS OF SURGERY*, 1915, lxi, 367).

The operation lasted for three hours, was very tedious and as the vessels were friable there was considerable bleeding. Temporary ligatures were placed above and below the suture points in both vessels in case secondary hemorrhage should make it necessary to ligate these vessels. The patient had several small secondary hemorrhages which were controlled by packing.

On about the tenth day following the operation a furious secondary hemorrhage occurred making it necessary to ligate both vessels. A few days following the ligation, although the limb seemed warm and the collateral circulation fairly well established, the patient collapsed and died apparently from sudden failure of the circulation. Death probably resulted from embolism.

#### FRACTURE-DISLOCATION OF HUMERUS; RUPTURE OF AXILLARY ARTERY; GAS BACILLUS INFECTION

DR. JOHN SPEESE reported the following case: Mrs. M. K., aged fifty-six, was admitted to the Polyclinic Hospital, July 12, 1915, suffering from shock and injuries following a fall from a trolley car. On examination, numerous superficial abrasions were found, an extensive swelling over the left shoulder-joint was present, the patient was

unable to move the left arm or hand and absence of the radial pulse on this side was noted. Under nitrous oxide anæsthesia crepitus was elicited, but a dislocation of the humeral head could not be definitely determined because of the extensive swelling. An X-ray taken immediately afterward, showed fracture of the surgical neck and marked displacement of the head of the humerus.

On the following day as there was slight swelling and cyanosis of the hand, and no return of the radial pulse, operative interference was necessary as the axillary artery seemed to be either injured or pressed upon by the dislocated head of the humerus. An incision made in the line of the artery released a large amount of clotted blood, the almost completely detached head of the humerus was excised, and the irregular and jagged projections from the shaft of the humerus were removed. On sponging out some of the clotted blood in the region of the axillary artery, a completely detached portion of the vessel, three centimeters in length was found. The torn vessel contained a thrombus in both ends, from which there was no bleeding. End-to-end suture of the artery was impossible because of the amount of tissue lost and because of the torn and ragged condition of the vessel. The circumflex artery was noted immediately above the proximal end of the torn axillary artery, the thrombus apparently not interfering with its lumen for the vessel was pulsating vigorously and seemed already to have undergone some degree of compensatory dilatation.

On the following day the patient's arm was warm, did not exhibit any evidence of gangrene, although several blebs, in the region of the abrasions sustained at the time of the accident, were present and gave the crackling sensation characteristic of gas bacillus infection. Cultures and smears from the blebs were reported to contain the *bacillus aerogenes capsulatus*. Further attempt to save the patient's arm had to be abandoned on account of this complication, and a high amputation of the shoulder performed twelve hours after the blebs appeared. The flaps were not sutured, the wound was flushed thoroughly with peroxide of hydrogen and gauze soaked in this solution was packed loosely in the wound. The patient exhibited no other symptoms of infection due to the gas-forming bacillus, and the wound healed slowly by granulation.

DR. A. P. C. ASHURST said that during the past summer he had had a similar case of gas bacillus infection under his care at the Episcopal Hospital. When he came on duty in the wards the patient had been in the hospital for a couple of days with a compound fracture in the upper part of the humerus (railroad crush). Two days later amputation was done for gangrene. In cutting through the deltoid, gas escaped. He put aside the knife he was using and completed

## ENDARTERITIS OBLITERANS.

the operation with a second knife. Emphysematous gangrene spread up to the shoulder and partly along the chest; it then stopped and the patient got well. Cultures showed the presence of the *B. aërogenes capsulatus*.

### ATLO-AXOID DISEASE

DR. J. T. RUGH read a paper, with the above title, illustrating it with lantern demonstrations.

## ENDARTERITIS OBLITERANS

DR. D. L. DESPARD read a paper with the above title.

DR. EDWARD B. HODGE said that he had a patient during the summer who suffered the most distressing pain and was absolutely unrelieved by morphia. The great toe only was affected and the pain was of the spasmodic variety. The Ringer's solution was tried and after the fifth or sixth injection there was improvement, but afterward the condition relapsed and was worse than before. From sixteen to eighteen injections were given, and there was no improvement; neither was there relief from morphia, of which he could take any amount. The man was finally relieved by amputation of the toe.

DR. E. G. ALEXANDER said that it might be of interest to report that one of the cases upon which Dr. Müller did an arteriovenous anastomosis, and which he mentioned among his failures, came later to Dr. Deaver's service at the Episcopal Hospital with a beginning gangrene of the toes of his other foot. He refused to have anything done surgically. He was put to bed with the limb elevated and given potassium iodide internally. He made a good recovery. He stated that this foot had felt exactly as the other prior to his operation at the University Hospital, as his toes were cold and numb.

DR. P. G. SKILLERN, JR., said, with reference to the practice of Dr. Stewart, who had stretched the sciatic nerve in cases of endarteritis obliterans, after the method of Chipault, to be effective the stretching must reach the nerve-trunk in whose trophic area the diseased vessel is situated. It seemed to him that a more intensive reaction in these nerves may be obtained by Réclus's operation of "neurotripsis," or dissociation of the nerve-fibres by a metallic instrument. Comparing the effects of nerve-stretching with those of nerve-laceration (neurotripsis) Smits, who made use of these procedures in the treatment of *maux perforants*, varicose veins and varicose leg ulcers, says that without any doubt nerve-laceration is more efficacious than stretching operations at ordinary distances, since lacerating the sciatic nerve is sufficiently radical to be followed by an action on its most distant

branches, while simple nerve-stretching has by no manner of means such an effect. Not only has neurotripsis an indirect influence upon the sympathetic system, thus increasing the trophic energy of the tissues, but it also frees the axis cylinders from the effects of pressure, which may be due to involvement of the nerve by extension of the cicatricial process from the blood-vessel (popliteal space; leg; varicose veins and cutaneous nerves), or else to disease of the vessels of the nerve itself (*arteria comes nervi ischiadici*; varicosities of veins within sciatic nerve), thus often accomplishing a double purpose, and often relieving nerve-pain at its *fons et origo*. What segment of the sciatic (or anterior crural) nerve is to be subjected to neurotripsis must vary with the individual case.

DR. N. GINSBURG remarked that there is nothing specific in the treatment of endarteritis obliterans of the type termed Buerger's disease. These cases are usually seen when the process is terminal, and all surgical measures are purely palliative in nature. Conservatism, when possible, should be employed in dealing with the devitalized extremities. However, if impending gangrene is present, early amputation will spare the patient much suffering and the danger of mixed infection. He had performed ligation of the femoral vein on five occasions, one of the patients being an old diabetic in coma, and in whom the operation had no value. The other four cases were typical cases of Buerger's disease. In one patient marked relief has occurred, following the loss of the big toe and the adjacent metatarsal bone, the foot has been spared. He was not prepared to state that the progress of the disease in this case was inhibited by the performance of the operation. The other three cases were failures, and one patient died with every evidence pointing to an ascending thrombus, occluding the vena cava and the renal veins. This case was a poor operative risk, and died of suppression of urine.

With regard to intravenous injections of sodium citrate solution, experience is too limited to definitely state what value can be placed upon this form of treatment.

DR. DESPARD, in closing, remarked regarding the salt solution, he did not use it in the cases reported. He had used the method in only one case and that was unsuitable for a fair test, for which reason he did not report it.

In reference to the neuritis, he thought that it is an ascending one. Whether all the pain and distress these patients suffer and the symptoms referable to the nerve are of secondary or primary origin he did not know. We have no evidence at this time from which to draw definite conclusions. There is something more than simply a clot in the vessels.

## AUTOGENOUS FASCIAL RECONSTRUCTION OF THE BILE-DUCT

DRS. NATHANIEL GINSBURG and JOHN SPEESE read a paper with the above title.

DR. JOHN H. JOPSON spoke of the first method of anastomosis, the direct suture of the divided ends of the common bile duct, in which there is no loss of substance, in order to place on record a case in which he did this operation with success. The patient was referred by Dr. John H. Musser, Jr., for operation for carcinoma of the pylorus. He had had an old ulcer and the carcinoma was thoroughly engrafted upon it. The gastro-hepatic omentum was extensively infiltrated, there was strong adhesion to the pancreas, and in resecting the stomach he got beyond the line of safety and cut completely across the common bile duct. He immediately clamped it off, completed the partial gastrectomy and did an end-to-end anastomosis of the bile duct with chromic catgut, suturing the union with a mattress stitch of linen anteriorly. The region was drained. There was profuse leakage of bile on the second and third days, which then stopped suddenly, and the man made a good recovery. He was in excellent health thirteen months later.

DR. P. G. SKILLERN, JR., called in question the permanency of the patency of the lumen of the bile duct, for the fundamental reason that the operators failed to provide an epithelial lining to their exotic duct. It is a law in surgical pathology that when the epithelial lining of a soft-tissue tube is destroyed or absent, and does not regenerate, the tube becomes involved in stricture-formation at the site of the missing epithelium. This law applies to the Eustachian tube, the œsophagus, the stomach (hour-glass stomach), the intestines (especially the rectum), the bile duct, the ducts of salivary glands (including the pancreas), the Fallopian tube, the ureter, and urethra. Taking the urethra, for example, the first stage of stricture-formation is destruction with permanent loss of epithelium followed by the formation of a granular patch and ultimately the inevitable cicatricial constriction; and no plastic operation for the permanent restoration of a patent lumen succeeds unless the exotic tissue transplant bears with it an epithelial lining. Another illustration is afforded by the behavior of intestinal fistulæ. Nothing closes so surely and rapidly as the large intestine fistula (cæcum) when not lined by epithelium; nothing is so sure to persist forever as a similar fistula when lined by epithelium from bowel to skin. Witness the persistency of branchiogenic fistulæ! Commenting upon Sullivan's method of reconstruction of the bile-ducts by



union by rubber tube of common or hepatic duct to duodenum, W. J. Mayo says, "This is by all means the simplest method of restoring the bile-channel, but unfortunately the newly-formed channel is not mucosa-lined, and we must expect that eventually contraction will take place . . . ." This is one reason why Walton's method of reconstruction, which was referred to by the essayists, appealed to him, for restoration is made by a pedicled duodenal flap. The second reason why he preferred Walton's method is based upon what seems to him to be irrefutable logic, namely, the pedicled duodenal flap is lined by mother epithelium from which the anlage of the hepatic bud is derived, so that by this method the place of the missing common duct is taken by homologous tissue lined by homologous epithelium, and provided epithelial edge of the graft has been accurately contacted with epithelial edge of duct-stump, with this proviso the chance of stricture-formation should be practically nil. Whether or not, in the plastic of the essayists, epithelial regeneration will spread from the duct-stump along the exotic fascia duct to the duodenum is problematic; if so, the situation would be saved; if not, the inevitable constriction which forms the basis of Mayo's argument against Sullivan's method will occur. In any event the interesting problem offers first-class opportunities for experimental investigation.

DR. GINSBURG replied, with reference to Dr. Skillern's contention that fascial reconstruction of the bile duct might be followed by subsequent stenosis, owing to the fact that the newly-established biliary tract is not lined by epithelium, that it must be borne in mind that the fistulous tracts most difficult to close are those which do not have an epithelial surface. We all know that perineal fistula, abdominal fecal fistula, and fistulous tracts about joints will persist indefinitely as long as there is the pressure of fluid for drainage. What they aimed to create, by the use of an autogenous fascial transplant, is a closed biliary fistula bridging over the gap in the bile duct as the result of injury or disease.

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#### ANNALS of SURGERY

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# INDEX TO VOLUME LXIV

## A

- Abdomen, Transverse Incisions in the Upper, 268.  
 Abdominal Diagnosis, Element of Error in, 39, 119.  
 Albee Operation for Relief of Spondylitis Deformans, 716.  
 Albuminuria, Orthostatic, 365.  
 ALEXANDER, E. G.: Endarteritis Obliterans, 751.  
 AMERICAN SURGICAL ASSOCIATION, 1916, President's Address Before, 129.  
 Amoebic Abscess of the Liver, 335.  
 Anæsthesia, Ether and Blood-pressure, 645; Minor, with Major Surgery, 589.  
 Aneurism, Arteriovenous Femoral, 747; Temporary Ligature for, 748; Thoracic, Condition of Cases Four Years After Wiring, 682.  
 Aneurismal Varix, Venous, 525.  
 Appendicitis, Chronic, Its Relation to Visceroptosis, 579; with Deceptive Symptoms, 510.  
 Appendix, Pseudomucinous Cyst of the, Complicating Ruptured Ectopic Gestation, 585; Sarcoma of the, 311; Vermiform, Cystic Dilatation of, 587.  
 ASHHURST, ASTLEY P. C.: Cases of Gas Bacillus Infection, 750. Operations for Relief of Ankylosis of the Shoulder, 369; Traumatic Spondylitis, 383; Treatment of Fracture of the Neck of the Femur, 125.  
 AXTELL, W. H.: Venous Aneurismal Varix, 525.

## B

- BAIRD, BEN D.: Intraparenchymatous Hemorrhage of the Spleen, 537.  
 BARBOUR, WILLIAM HOWARD: Segmental Resection for Gastric Ulcer, 527.  
 BARRIE, GEORGE: Regressive Changes in the Breast, 707.  
 BECKMAN, E. H.: Observations on the Diagnosis and Treatment of Trifacial Neuralgia, 242.  
 Bedstead, Four-post Fracture, 613.

- BEER, EDWIN: Bilateral Nephrolithiasis, 722; Carcinoma of the Bladder and Prostate, 94; Interpretation of Functional Renal Tests, 434; Removal of Foreign Body from Bronchus by Bronchoscopy, 92; Tuberculosis of Prostate and Kidney, 720.  
 Bile-duct, Autogenous Reconstruction of the, 753; Common, Rupture of the, 414; Cyst of the, 546.  
 Bile-passages, Anomalies of the, 419.  
 Bladder and Prostate, Carcinoma of, 94.  
 Blood Transfusion, Importance of Proper Dosage of Sodium Citrate in, 618.  
 Blood-pressure During Ether Anæsthesia, 645; and Prostatectomy, 659.  
 Bone Grafts into Skull Defects, 516.  
 Bone Transplantation, 519; for Sarcoma of Humerus, 106.  
 Borchgrevink's Extension Splint in Fractures of the Humerus, 353.  
 Bowel, Obstruction of the, Relieved by Enterostomy and Ileocolostomy, 112.  
 Brain, Abscess of, 117.  
 Branchial Fistula, 105.  
 Branchiogenic Carcinoma, 1.  
 Breast, Abnormal Involution of the, 699; Benign Tumors of, Removal Through Marginal Incision, 736; Carcinoma of, with Late Metastasis in Opposite Axilla, 737; Removal Through Stewart Incision, 736; Method of Treating Cysts of the, 254; Radical Operation for Carcinoma of, 629; Regressive Changes in the, 707.  
 BRENIZER, ADDISON G.: Total Bone Grafts into Skull Defects, 516.  
 Bronchiectasis, The Therapeutics of Chronic Non-tuberculous Suppurative, 8.  
 Bronchoscopy, Removal of Foreign Bodies by Means of, 92.  
 Bronchus, Foreign Body in, Removed by Bronchoscopy, 92.  
 BUGBEE, HENRY G.: Traumatic Injuries of the Kidney and Ureter, 459.

- BUMPUS, HERMON C., JR.: Rupture of the Common Bile-duct Associated with Subphrenic Abscess, 414.  
 Burn, Scar from, Degeneration into Epithelioma, 513.  
 BURNHAM, A. C.: Fractures about the Wrist in Childhood and Adolescence, 318.  
 Bursitis, Subacromial, 368.

## C

- Cæcum, Excision of, for Carcinoma, 499.  
 Carcinoma of Cæcum, Excision of, 499; of Colon, Excision of, 501; Operation for, 505; Melanotic, 206; of Penis, Total Extirpation of, 719; of the Rectum and Rectosigmoid, Radical Operation for, 304; of Sigmoid, Excision of, 500; of Tubercular Lymph-nodes, 355; of Uterus, Radium Treatment of, 298, 602.  
 Carotid Body, Tumors of the, 257.  
 Cervical Vertebra, Dislocation of the First, 248.  
 CHAMBERS, THOMAS R.: Epithelioma Immediately Following Burn, 513.  
 Children with Tuberculosis of the Spine, Handling of, while under Anæsthetic, 34.  
 Cholecystitis, 508.  
 Choledochus Cyst, 546.  
 Chondro-osteosarcoma in a Dog, Transplantable, 58.  
 CLARK, JOHN G.: Results Obtained by the Use of Radium in the Treatment of Cancer of the Uterus, 602.  
 Cleft Palate, Method of Closing, 115.  
 COLEY, WILLIAM B.: Late Recurrence after Removal of Cancer of the Breast, 742; Melanotic Cancer, 206; Results after Removal of Chronic Mastitic Tumors, 740.  
 COLLINS, CLIFFORD U.: Surgery of the Gall-bladder, 48.  
 COLLINS, HOWARD D.: Traction Bandage for Reduction of Fracture of the Leg, 65.  
 Colon, Excision of, for Cancer, 501; Operation for Carcinoma of, 505.

- CONNELL, KARL: Bullet Wound of the Knee, 97; Cases of Knee-Joint Infection, 99; Knee-Joint Perforated by Rusty Nail, 98; Major Surgery Under Minor Anæsthesia, 632.  
 COTTON, FREDERIC J.: Os Calcis Fracture, 480.  
 CRILE, GEORGE W.: The Technic and Management of Operations on the Stomach, 290.  
 Cysts of the Jaw, Tooth Germ, 674.

## D

- DARRACH, WILLIAM: Fracture of Lower Articular Surface of Humerus, 724.  
 DAVID, VERNON C.: Results of Operative Treatment of Exophthalmic Goitre, 400.  
 DAVIS, GWILYM G.: Operations for Relief of Ankylosis of Shoulder, 369.  
 DAVIS, JOHN STAIGE: Partial Epiphyseal Transplantation for Defect in Fibula, 519.  
 DEEVER, JOHN B.: More Radical Treatment of Duodenal and Gastric Ulcer, 294; Surgical Treatment of Exophthalmic Goitre, 488.  
 DELATOUR, HENRY B.: Late History of Operations for Cystic Mastitis, 743.  
 Dilatation of the Stomach, Acute Post-operative, 107.  
 DORRANCE, GEORGE M.: Felons, 716.  
 DOUGLAS, JOHN: Mucous Membrane Plastic After Removal of Epulis, 363; Pylorectomy for Gastric Ulcer, 508; Traumatic Epilepsy, the Result of Trephining for, 732.  
 DOWD, CHAS. N.: Branchial Fistula, 105.  
 DOWNES, W. A.: Cæcum, Excision of, for Carcinoma, 499; Hemorrhage after Gastro-enterostomy, 497; Hypernephroma, Permanent Recovery after Operation, 499.  
 Duodenal and Gastric Ulcer, More Radical Treatment of, 294; Ulcer, Perforated, 507, 625; Operations for, 410.  
 Duodenum, Retroperitoneal Rupture of the, by Blunt Force, 550.

# INDEX

## E

- Ectopic Gestation, Ruptured, Complicated by Cyst of the Appendix, 585.
- EISENDRATH, DANIEL N.: Undescended Testis, 324.
- ELMER, WALTER G.: Handling of Children with Tuberculosis of the Spine under Anæsthetic, 34.
- ELSBERG, CHARLES A.: Bone Transplantation for Sarcoma of the Humerus, 106; Diseases of Spinal Cord and Its Membranes, Review of, 636.
- Empyema of the Thorax, Thoracotomy, 509.
- ENSTAD, J. E.: Device for Warming Ether During Inhalation, 601.
- Epilepsy, Traumatic, 731.
- Epiphysial Transplantation for Defect in Fibula, 519.
- Epithelioma Immediately Following Burn, 513.
- Epulis, Removal of, Followed by Mucous Membrane Plastic, 363.
- ERDMAN, JOHN F.: The Stewart Incision for Removal of Carcinoma of the Breast, 630; Treatment of Cystic Mastitis, 743.
- Erysipelas Complicated by Streptococic Peritonitis, 379.
- ESTES, WILLIAM LAWRENCE: Fractures of the Femur, 74.
- Ether, Device for Warming, During Inhalation, 601.
- European War, Surgical Lessons of, 136.
- Exophthalmic Goitre, 385; Results of Operative Treatment of, 400; Surgical Treatment of, 487.
- Extensor of Digits, Supernumerary, 380.

## F

- FAUNTLEROY, A. M.: Surgical Lessons of the European War, 136.
- Felons, 716.
- Femoral, Arteriovenous Aneurism, 747.
- Femur, Fracture of the, 74, 122; Neck of the, Treatment of, 125, 505; Sarcoma of, 357.
- FINKELSTEIN, HARRY: Spondylitis Deformans Relieved by Albee Operation, 713.

- FISCHER, HERMAN: Cyst of the Appendix, 735; Primary Melanosarcoma of the Retro-orbital Tissue, 726; Total Extirpation of Penis for Carcinoma, 719.
- FISK, ARTHUR L.: Siphon Drainage of the Thorax, 731.
- FLINT, JOSEPH MARSHALL: Localization and Extraction of Projectiles, 151; The Four-post Fracture Bedstead, 613.
- Follow-up System, Surgical, 349.
- Foreign Body in the Œsophagus, 495.
- FOSS, HAROLD L.: The Element of Error in Abdominal Diagnosis, 39.
- FOWLER, RUSSELL S.: Choledochus Cyst, 546.
- Fracture of Anatomical Neck of Humerus, 105; of Both Patellæ, Union Without Suture, 116; of the Leg, Traction Bandage for Reduction of, 65; of Lower Articular Surface of Humerus, 724; of Neck of Femur, 505; of the Os Calcis, 480; of Skull, Decompression and Drainage, 746; Through the Neck of the Radius, 511; Treatment of, with Traction Tongs, 500.
- Fracture-Bedstead, The Four-post, 613.
- Fracture-Dislocation of Humerus, 749.
- Fractures, Sliding Graft and the Kangaroo Suture in Fresh, 68; of the Femur, 74, 122; About the Wrist in Childhood and Adolescence, 318.
- Fractures and Dislocations, A Text-book of, by Kellogg Speed, Review of, 634; Treatise on, by John B. Roberts and James A. Kelly, Review of, 633.
- FRANK, L. W.: Traumatic Spondylitis, 381.
- FRAZIER, CHAS. H.: Endothelioma of the Spinal Cord, 383; Surgical Treatment of Goitre, 489; System of Keeping Surgical Records, 347.
- FREEMAN, LEONARD: Chronic General Infection with the Bacillus Pyocyaneus, 195.
- Frontal Sinus, Anatomy of the, in Man, 666.

G

- Gall-bladder and Bile-passages, Anomalies of the, 419; Surgery of the, 48.  
 Gastric and Duodenal Ulcers, Operations for Perforated, 410; Ulcer, Pylorotomy for, 508; Segmental Resection of Stomach for, 527.  
 Gastro-enterostomy; Consecutive Hemorrhage; Transfusion, 361; Secondary Hemorrhage, 496.  
 Gastrojejunostomy Followed by Perforation at the Stoma Two Years Later, 375.  
 GERSTER, ARPAD G.: Traumatic Infection of the Knee-joint, 100.  
 GIBBON, JOHN H.: Element of Error in Abdominal Diagnosis, 119; Temporary Ligatures in Cases of Aneurism, 748.  
 GIBSON, CHARLES L.: A Surgical Follow-up System, 349.  
 GINSBURG, NATHANIEL: Cyst of the Appendix Complicating Ruptured Ectopic Gestation, 585; Endarteritis Obliterans, 752; Fracture of Skull, Decompression and Drainage, 746.  
 Goitre, Exophthalmic, 385; Results of Operative Treatment of, 400; The Surgical Treatment of, 395, 487; Toxic, in Young Girl, 371.  
 GRAVES, STUART: Cystic Dilatation of the Vermiform Appendix, 587.  
 GREEN, NATHANIEL: Foreign Body in Oesophagus, 495; Treatment of Cystic Mastitis, 739.

H

- Hæmolytic Jaundice, Splenectomy for, 627.  
 Hæmothorax, Traumatic Siphon Drainage for, 728.  
 Hand, Supernumerary Muscle of the Dorsum of the, 615.  
 HARTWELL, JOHN A.: Acute Post-operative Dilatation of the Stomach, 107; Carcinoma of Cervical Lymph-nodes, 355; Intestinal Obstruction Due to Tubercular Lymph-nodes, 353; Operation for Carcinoma of Colon, 505; Result After Operation for Chronic Cystic Mastitis, 740; Sarcoma of Femur, 357.

- Heart, Migration of Shell Fragment into, from Femoral Vein, 734.  
 Hemorrhage after Gastro-enterostomy; Transfusion, 361.  
 Hernia, Left Inguinal, Associated with Undescended Testis, 504; Richter's, with Acute Obstruction, 119; Ventral, 364.  
 HEWSON, ADDINELL: Supernumerary Extensor of the Digits, 380.  
 HITZROT, JAMES M.: Treatment of Cystic Mastitis, 740.  
 HODGE, EDWARD B.: Endarteritis Obliterans, 751; Femoral Arteriovenous Aneurism, 747.  
 HOGUET, JOSEPH P.: Melanotic Cancer, 206.  
 HOOKER, RANSOM S.: Intussusception in an Adult, 624.  
 HOTCHKISS, LUCIUS W.: Intussusception Due to Tumor Within Small Intestine, 365; Osteoplastic Resection of the Skull, 503.  
 Humerus and Femur, Sarcoma of, 118.  
 Humerus, Fracture of, Treated by Borchgrevink's Extension Splint, 353; Fracture of Lower Articular Surface of, 724; Fracture-Dislocation of, 749; Sarcoma of the, Bone Transplantation for, 106.  
 Hypernephroma, Permanent Recovery after Operation, 499.

I

- Injuries on Transportation Systems, Methods of Handling, 184.  
 Intestinal Obstruction from Richter's Hernia, 119; Due to Tubercular Lymph-nodes, 353.  
 Intussusception in an Adult, 624; Due to Tumor Within Small Intestine, 365.

J

- Jaw, Tooth Germ Cysts of the, 674.  
 JONAS, A. F.: Dislocation of the First Cervical Vertebra, 248.  
 JOPSON, JOHN H.: Element of Error in Abdominal Diagnosis, 120; Reconstruction of Divided Common Bile-duct, 753.

K

- KENYON, JAMES H.: Siphon Drainage for Traumatic Hæmothorax, 728; Traumatic Epilepsy Relieved by Trephining, 731.  
Kidney, Stone in the, Bilateral, 722; Tuberculosis of, 628, 720; and Ureter, Traumatic Injuries of the, 459.  
Knee, Jig-saw Osteotomy for Deformity of, 91.  
Knee-joint, Bullet Wound of, 97; Gunshot Wounds of the, 100; Infection, Cases of, 99; Perforation of, By Rusty Nail, 98; Tuberculous and Luetic Infection of, 371.

L

- LATHROP, WALTER: The Sliding Graft and the Kangaroo Suture in Fresh Fractures, 68.  
LAWS, GEORGE M.: Mesenteric Thrombosis, 378; Streptococcic Peritonitis Complicating Erysipelas, 379.  
LECONTE, ROBERT G.: Preparedness, 129.  
LEE, BURTON J.: Acute Post-operative Dilatation of the Stomach, 112; Enterostomy and Ileocolostomy for Obstruction of the Bowel, 112.  
Leg, Reduction of, Traction Bandage for, 65.  
LEWALD, LEON T.: Acute Post-operative Dilatation of the Stomach, 110.  
LEWISOHN, RICHARD: The Importance of the Proper Dosage of Sodium Citrate in Blood Transfusion, 618.  
LILIENTHAL, HOWARD: Indications after Bronchoscopy, 93; Empyema of the Thorax, Thoracotomy, 509-510; The Therapeutics of Chronic Non-tuberculous Suppurative Bronchiectasis, 8; Transthoracic Exploration of Oesophagus for Stricture, 94.  
Localization and Extraction of Projectiles, 151.  
Lung, Abscess of, 495.  
LUSK, WILLIAM C.: Condition of Two Cases of Thoracic Aneurism Four Years After Wiring, 682.  
LYLE, H. H. M.: Borchgrevink's Extension Splint for Fracture of the

Humerus, 353; Gunshot Wounds of the Knee, 100; Jig-saw Osteotomy for Deformity of Knee, 91; Shell Fragment Migration from Femoral Vein to Heart, 734.

M

- MACKENZIE, KENNETH A. J.: Method of Handling Injuries on Transportation Systems, 184.  
MACLAREN, ARCHIBALD: Chronic Appendicitis and Its Relation to Visceroptosis, 579.  
Major Surgery Under Minor Anæsthesia, 589.  
MARTIN, WALTON P.: Disease of the Nipple, 725.  
Mastitis, Chronic Cystic, 699, 739.  
MATHEWS, FRANK S.: Excision of Ulcer of Stomach, 363; Fracture of Anatomical Neck of Humerus, 105.  
MATLACK, GRANVILLE T.: Surgical Treatment of Exophthalmic Goitre, 487.  
MAYO, WILLIAM J.: Radical Operation for Cancer of the Rectum and Rectosigmoid, 304.  
MCLEAN, JOHN D.: Treatment of Exophthalmic Goitre, 489.  
MCWHORTER, JOHN E.: Transplantable Chondro-osteosarcoma in a Dog, 58.  
MEANS, JOHN W.: Cysts of the Urachus, 53.  
Melanosarcoma of the Retro-orbital Tissue, 726.  
Melanotic Cancer, 206.  
Mesenteric Thrombosis, 378.  
MEYER, WILLY: Late Recurrence after Operation for Carcinoma of the Breast, 742; Operation for Carcinoma of Penis, 719; Removal of Foreign Body from Bronchus by Bronchoscopy, 93; Results of Trephining for Traumatic Epilepsy, 733; Siphon Drainage of the Thorax, 729.  
MILLER, ROBERT TALBOTT: Acute Suppurative Pancreatitis, 329; Retroperitoneal Rupture of the Duodenum by Blunt Force, 550.  
MILLIKEN, SETH M.: Appendicitis with Deceptive Symptoms, 510; Major

- Surgery under Minor Anæsthesia, 631; Thrombo-angiitis Obliterans, 105.
- MOSCHCOWITZ, ALEXIS V.: Breast Carcinoma with Late Metastasis in Opposite Axilla, 737; Marginal Incision for Extirpation of Tumors of the Breast, 736; Orthostatic Albuminuria, 365; Stewart Incision for Removal of Carcinoma of Breast, 736; Stewart Operation for Removal of the Breast, 744; Thrombo-angiitis Obliterans, 104; Transverse Incisions in the Upper Abdomen, 268; Ventral Hernia, 364.
- MÜLLER, GEORGE P.: Treatment of Fracture of the Femur, 122.
- MUNS, WALDEN E.: Blood-pressure Graphic Vasomotor Changes in the Periphery During Ether Anæsthesia, 645.
- ## N
- Neck, Cancer of Lymph-nodes of, 355.
- Nephrolithiasis, Bilateral, 722.
- Neuralgia, Trifacial, Diagnosis and Treatment of, 242.
- NEW YORK SURGICAL SOCIETY, Transactions of the, 91, 102, 107, 353, 495, 503, 624, 719, 725.
- Nipple, Paget's Disease of the, 725.
- Nose and Throat, Thomson's Text-book of the Diseases of, Review of, 635.
- ## O
- Obstruction of the Bowels Due to Tubercular Lymph-nodes, 353.
- OCHSNER, ALBERT J.: Exophthalmic Goitre, 385; Surgical Treatment of Goitre, 491.
- Oesophagus, Foreign Body in the, 495; Transthoracic Exploration of, for Stricture, 94.
- Orbital Tissue, Primary Melanosarcoma of the Deep, 726.
- Os Calcis, Fracture of the, 480.
- ## P
- Paget's Disease of the Nipple, 725.
- Pancreatitis, Acute Suppurative, 329.
- Patellæ, Transverse Fracture of Both, Bony Union Without Suture, 116.
- PEACOCK, ALEXANDER HAMILTON: Blood-pressure and Prostatectomy, 659.
- Penis, Total Extirpation of, for Carcinoma, 719.
- Peritonitis, Streptococcic, Complicating Erysipelas, 379.
- PFEIFFER, DAMON B.: Case of Supernumerary Extensor of the Digits, 380; Pathology of Stiff Shoulders, 370; Supernumerary Muscle of the Dorsum of the Hand, 615.
- PHILADELPHIA ACADEMY OF SURGERY, Transactions of the, 115, 368, 495, 746.
- Phthalein and Indigocarmine Renal Tests, Interpretation of, 434.
- PORTER, MILES F.: The Surgical Treatment of Goitre, 395, 494.
- Preparedness, 129.
- PRIME, FREDERICK, JR.: Transplantable Chondro-osteosarcoma in a Dog, 58.
- Projectiles, Localization and Extraction of, 151.
- Prostate, Carcinoma of the, 94; Tuberculosis of the, 720.
- Prostatectomy and Blood-pressure, 659.
- Pylorus, Resection for Ulcer of, 360.
- Pyocyaneus Infection, 195.
- ## R
- Radium Treatment of Uterine Cancers, 298, 602.
- Radius, Fracture Through the Neck of the, 511.
- RANSOHOFF, JOSEPH: Radium Treatment of Uterine Cancers, 298.
- Records, System of Keeping Surgical, 347.
- Rectum and Rectosigmoid, Cancer of the, Radical Treatment for, 304.
- Renal Tests, Functional, Interpretation of, 434.
- ROBERTS, JOHN B.: Bony Union of Fracture of Both Patellæ Without Suture, 116; Further Note on Etiology of Surgical Scarlatina, 203; Method of Closing Wide Cleft Palate, 115; Treatment of Fracture of the Femur, 122.
- Roberts and Kelley, Treatise on Fractures, Review of, 633.

- RODMAN, J. STEWART: Abscess of Brain, 117; Acute Intestinal Obstruction from Richter's Hernia, 119; Femoral Arteriovenous Aneurism, 749; Sarcoma of Humerus and Femur, 118.
- ROSS, GEORGE G.: Perforation at the Stoma Two Years After Gastrojejunostomy, 375.
- RUSSELL, JAMES I.: Splenectomy for Hæmolytic Jaundice, 627; Tuberculosis of Kidney, 628.

## S

- Sarcoma of the Appendix, 311; of Femur, 357; of the Orbit, 726.
- SAWYER, A. W.: Toxic Goitre in Young Girl, 371.
- Scarlatina, Surgical Note on Etiology of, 203.
- SCHACHNER, AUGUST: Anomalies of the Gall-bladder and Bile-passages, 419.
- SCHAEFFER, J. PARSONS: Further Observations on the Anatomy of the Sinus Frontalis in Man, 666.
- SCHLEY, WINFIELD SCOTT: Delayed Recurrence after Removal of Carcinoma of the Breast, 741; Siphon Drainage of the Thorax, 729.
- Segmental Resection for Gastric Ulcer, 527.
- SHEA, JOHN F.: Report of Nine Consecutive Operations for Gastric and Duodenal Ulcers, 410.
- Shell Fragment, Migration into Heart from Femoral Vein, 734.
- SHEPHERD, FRANCIS J.: Method of Treating Cysts of the Breast, 254.
- Shoulder Ankylosis, Operations for Relief of, 368.
- Sigmoid, Excision of, for Carcinoma, 500.
- Sinus Frontalis in Man, the Anatomy of the, 666.
- Siphon Drainage for Traumatic Hæmothorax, 728.
- SKILLERN, P. G., JR.: Endarteritis Obliterans, 751; Reconstruction of Divided Common Bile-duct, 753.

- Skull Defects Followed by Total Bone Grafts, 516; Fracture of the, Decompression and Drainage for, 746; Osteoplastic Resection of the, 503.
- SMITH, CHARLES HENDEE: Acute Post-operative Dilatation of Stomach, 110.
- SMITH, T. A.: Fracture Through the Neck of the Radius, 511.
- Sodium Citrate, the Importance of the Proper Dosage of, in Blood Transfusion, 618.
- Speed, Kellogg, Text-book of Fractures and Dislocations, Review of, 634.
- SPEESE, JOHN: Fracture-dislocation of Humerus, 749.
- Spinal Cord, Endothelioma of the, 383; and Its Membranes, Diseases of, by Charles A. Elsberg, Review of, 636.
- Spine, Tuberculosis of the, Handling of Children With, While Under Anæsthetic, 34.
- Spleen, Intraparenchymatous Hemorrhage of the, 537.
- Splenectomy for Hæmolytic Jaundice, 627.
- Spondylitis Deformans Relieved by Albee Operation, 713; Traumatic, 381.
- STEWART, GEORGE D.: Cholecystitis, 508; Segmental Resection for Gastric Ulcer, 527.
- Stewart Incision for Removal of Breast for Carcinoma, 629, 736.
- Stomach, Acute Post-operative Dilatation of the, 107; Perforated Ulcer of the, Surgical Treatment of, 403; More Radical Treatment of Ulcers of the, 294; Resection of Pylorus for Ulcer of, 360; Segmental Resection of, for Ulcer, 527; Technic and Management of Operations on the, 290.
- Subphrenic Abscess Associated with Rupture of Common Bile-duct, 414.
- Surgical Records, System of Keeping, 347.
- SYMS, PARKER: Chronic Abnormal Cystic Mastitis, 699; Chronic Cystic Mastitis, 745; Excision of Cancer of Colon, 501; Excision of Carcinoma of the Sigmoid, 500; Tongs for Traction in Treatment of Fracture, 500.



T

- TAYLOR, ALFRED S.: Siphon Drainage of the Thorax, 730; Results of Trephining for Traumatic Epilepsy, 733.
- TAYLOR, KENNETH: Tissue Fragments and Wound Infection, 641.
- Testis, Undescended, 324; With Inguinal Hernia, 504.
- THOMAS, T. TURNER: Pathology of Stiff Shoulders, 370.
- THOMSON, ST. CLAIR: Diseases of the Nose and Throat, Review of, 635.
- Thoracic Aneurism, Condition of Two Cases Four Years After Wiring, 682.
- Thorax, Empyema of, Thoracotomy, 509, 510.
- Thrombo-angiitis Obliterans, 102.
- Thrombosis of Mesenteric Veins, 378.
- TILTON, BENJAMIN T.: Abscess of Lung, 495; Cases of Stewart Incision for Removing Carcinoma of Breast, 629; Transfusion for Hemorrhage After Gastro-enterostomy, 496.
- Tissue Fragments and Wound Infections, 641.
- Tongs for Traction in Treatment of Fracture, 500.
- Tooth Germ Cysts of the Jaw, 674.
- TOREK, FRANZ: Hemorrhage After Gastro-enterostomy, 498.
- Transplantation, Partial Epiphysial, for Defect in Fibula, 519.
- Transportation Systems, Methods of Handling Injuries on, 184.
- Transverse Incisions in the Upper Abdomen, 268.
- Traumatic Injuries of the Kidney and Ureter, 459.
- Trifacial Neuralgia, Diagnosis and Treatment of, 242.
- Tuberculosis of Kidney, 628; of Prostate and Kidney, 720; of the Spine, Handling of Children With, While Under Anæsthetic, 34.
- Tuberculous Infection of Knee-joint, 371.

U

- Urachus, Cysts of the, 53.
- Uterine Cancers, Radium Treatment of, 298.

- Uterus, Cancer of the, Results Obtained in the Use of Radium in the Treatment of, 602.

V

- VAN BEUREN, FRED T.: Perforated Duodenal Ulcer, 625; Thrombo-angiitis Obliterans, 102.
- Ventral Hernia, 364.
- Vertebra, Dislocation of the First Cervical, 248.
- Visceroptosis, Relation of Chronic Appendicitis to, 579.

W

- WALKER, JOHN B.: Fracture of Neck of Femur, 505; Undescended Testis Associated with Inguinal Hernia, 504.
- WARNER, FRANK: Branchiogenic Carcinoma, 1.
- WEBER, GEORGE H.: Surgery of the Gall-bladder, 48.
- WIENER, JOSEPH: Acute Post-operative Dilatation of the Stomach, 109; Major Surgery under Minor Anæsthesia, 589; Operation for Carcinoma of the Breast, 630; Operation for Carcinoma of the Sigmoid, 502.
- WILENSKY, ABRAHAM O.: The Surgical Treatment of Perforated Ulcer of the Stomach, 403.
- WINSLOW, RANDOLPH: Tumors of the Carotid Body, 257.
- WOHL, MICHAEL G.: Sarcoma of the Appendix, 311; Tooth Germ Cysts of the Jaw, 674.
- WOOD, ALFRED C.: Amœbic Abscess of the Liver, 335.
- WOOLSEY, GEORGE: Acute Post-operative Dilatation of the Stomach, 107; Chronic Perforation of Duodenal Ulcer, 507; Recurrent Hemorrhage after Gastro-enterostomy; Transfusion, 361; Resection of Pylorus for Ulcer, 360.
- Wound Infection and Tissue Fragments, 641.
- Wrist Fractures in Childhood and Adolescence, 318.

Y

- YOUNG, JAMES K.: Subacromial Bursitis, 368; Tuberculous and Luetic Infection of Knee-joint, 371.

